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NUCLEAR SCIENCE ABSTRACTS

Vol. 2 No. 4

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ABSORPTION AND SCATTERING OF RADIATION

893 Range Distribution of the Charge Particles from the D-D Reactions for 10-Mev Deuterons: Differential Elastic Scattering Cross Section at 20 Deg., 30 Deg., and 40 Deg. in the Laboratory System by F K Tallmadge, J H Williams and L Rosen. AECU-91 (AD-14) nd 2p

This document is an abstract; it is reproduced below in its entirety.

Photographic plates were used to determine the range distributions of all charged particles from the D-D reactions as well as the absolute intensity of the elastically scattered deuterons for 10-Mev deuterons from the Los Alamos cyclotron. These measurements were made at 40 deg., 30 deg., and 20 deg. (laboratory coordinate system) with respect to the incident beam which was focused on a "thin" deuterium gas target 15 ft, from the cyclotron.

At 40 deg. all of the charged particles from the above reactions (protons, tritons, He^3's, and elastically scattered deuterons) were clearly resolved. At 20 deg. the triton and deuteron mean ranges differed by less than three per cent and hence could not be resolved.

Slit systems were used to define the number of tracks originating in a given swath across the photographic plate. This, together with the high degree of resolution of scattered deuterons from other charged particles (at 20 deg. the energy width at half maximum of the scattered deuterons was three per cent), permitted precise determinations of the differential D-D scattering cross-section. Accurate determinations of beam direction, beam energy, maximum beam energy spread, and purity of target gas were made from the same plates which yielded the cross section determinations.

894 The Dependence of the Range of Electrons on Their Energy (Die Abhängigkeit der Reichweite der Elektronen von ihrer Energie) by Richard Glocker Z Naturforsch 3a 147-151 (1948) March. (In German)

An approximation formula is developed in the manner of Flammersfeld's formula Z Naturforsch 2a 370 (1947) for the practical and true ranges in the energy range from 15 Kev up to almost 100 Mev. An approximation formula is also developed for the specific ionization of air from 4 to 200 Kev. The author then attempts to explain the small differences among true, practical, and maximum ranges. Curves are given, also 28 references.

895 Scattering of Like Particles at 100 Mev by F C Barker and D G Ravenhall Nature 163 20 (1949) Jan 1

Previous calculations [Nature 161 726 (1948)] of the cross-sections for neutron-proton scattering at 100 Mev have been extended to the case of scattering of like particles. The differential cross section for neutron-neutron and proton-proton scattering (per unit solid angle) is shown as a function of the scattering angle for both symmetric and exchange forces. As in the neutron-proton case, the difference between the scattering for exchange and for symmetric forces is appreciable only at extreme angles, however, the former is always the greater, so that the total cross-section for exchange forces is significantly larger than that for symmetric forces. The total cross-sections, including for comparison those for neutron-proton scattering, are:

	Exchange force	Symmetric force
Neutron-neutron	$9{\cdot}1 \times 10^{-26}$ cm.^{2}	$5{\cdot}9 \times 10^{-26}$ cm.^{2}
Neutron-proton	$8{\cdot}7 \times 10^{-26}$ cm.^{2}	$8{\cdot}8 \times 10^{-26}$ cm.^{2}

ATOMIC BOMBS AND WARFARE

896 No Place to Hide by David Bradley. Boston, Little, Brown and Co 1948. 182p

This is the log of a doctor who was assigned to duty with Operations Crossroads. He was one of the men of the Radiological Safety Section whose duty it was to stand guard with Geiger counters for invisible danger from radioactivity. The account covers the period May 29 - October 10, 1946. The main events recorded are Able Day and Baker Day on Bikini. The author believes that in the indiscriminate use of atomic energy for political coercion the survival of the human race is at stake.

ATOMIC BOMBS AND WARFARE (continued)

He believes also that there is no defense against atomic weapons, there are no satisfactory countermeasures and methods of decontamination, nor are there any satisfactory medical or sanitary safeguards for the people of atomized areas. The appendix is "a layman's guide to the dangers of radioactivity" and contains a section on the fundamentals of atomic physics.

ATOMIC POWER

897 Atomic Power and Aircraft Propulsion by Andrew Kalitinsky SAE Quarterly Transactions 1-17 (1949) Jan See Nuclear Science Abstract I-729.

BIOLOGY, GENERAL

898 A Second-Year Inhalation Toxicity Study of Animals Employing Uranyl Nitrate Hexahydrate at 4 mg/m^3 by G F Sprague Jr, A Pettengill, B Brown, H E Stokinger. AECD-2442 (UR-51) Dec 19 1948 Decl Jan 1949 56p For publication in NNES

The chronic toxicity of uranyl nitrate hexahydrate has been studied for a second year in 23 dogs and 70 rats. The exposure conditions and toxicologic procedures resembled closely those of the previous year, but considerably more study was given to the determination of particle size of the nitrate dust. As a result of the exposure to uranyl nitrate hexahydrate dust at 4 mg/m^3 daily for a econd year, the following observations are made. The mortality among dogs and rats that could probably be attributed to uranium exposure was confined to 2 dogs previously exposed to uranium dioxide and one rat exposed to the nitrate, although the overall mortality amounted to 65% of all animals dying or sacrificed because of advanced age or disease. Little change occurred in weight response in any of the animal groups with the exception of the dogs exposed previously to uranium dioxide and tetrafluoride. Dogs exposed previously to UF_6 showed greatest weight gain at the end of the second year; rats previously exposed to this compound were the only ones to lose weight. A greater number of abnormal values among biochemical constituents both in blood and urine appeared in the animals during the second year than during the first year. The greatest number and degree of changes occurred among those animals exposed to uranium compounds that produced the least effect during the first year, namely UO_2 and UCl_4. Animals previously exposed to the same level of the nitrate as in the current study showed fewest changes. Renal injury was found in all animals exposed, characterized respectively by necrosis, cellular desquamation and regeneration or tubular atrophy. The hematologic finding of anemia among both dogs and rats was noteworthy. Again this anemia was most marked in animals whose prior exposure had been to UO_2, UF_4 and UCl_4. The anemias observed were confined to decreases in red blood cell count and hemoglobin content, and were not associated with a rise in the percentage of reticulocytes. One of the more important observations from the second year study was the deposition of uranium in the tissues. Among the important depots of uranium storage were the bones and teeth.

899 A Micro Method for the Determination of the Nucleic Acids by Robert Steele, Theodore Sfortunato and Lina Ottolenghi. AECU-57 (BNL) nd 13p

A micro-modification of the Schneider method for the determination of the nucleic acids in tissues has been developed. This modification makes possible the analysis of tissue samples weighing 1 to 3 mg. (wet weight) and containing a total of 1 to 15 micrograms of desoxyribose nucleic acid and 8 to 60 micrograms of ribose nucleic acid. The original method was devised for animal tissue; the present modification extends its usefulness to certain plant material and to tissues of which only very small samples are available.

900 Observations on the Growth Factor Requirements of Allomyces by K E Yaw. AECU-68 (BNL) nd 5p Proposed for publication in Science

Strains of four species of the water mold Allomyces, were obtained. The species included A. arbusculus (Phil. Is. 1), A. cystogenus (Burma 1B), A. javanicus (Burma 1Da) and A. moniliformis (North Carolina 3). In the experiments reported in this paper, the fungi were grown in 20 ml of medium

BIOLOGY, GENERAL (continued)

per 125 ml Erlenmeyer flask, incubated at 30°C for seven days, after which the dry weight of the mycleium was determined. The minimal medium is described. The essential growth factors and the accessory or complementary growth factors for the four species of Allomyces are given. All four of the species grew slightly with only methionine added to the minimal medium. However, the addition of thiamin plus methionine to the minimal medium caused a tenfold increase in the amount of growth. The increase in weight of A. arbusculus following the addition of tryptophane was not of such magnitude as the addition of thiamin. The increase in dry weight of the fungi due to the addition of tryptophane was detected when it was found that the fungus grew better in medium containing thiamin, methionine and the remaining essential amino acids. By elimination, it was found that the increase in growth was due to the addition of tryptophane. Under the conditions outlined above, the optimum amounts of both essential and complementary factors necessary to give maximum growth are given also in a table. The physiological properties reported in this paper seem to substantiate previous evidence of close relationship between the established species in this genus.

901 The Gross Metabolism of o- and p- Aminobenzoic Acid in Mice by L J Roth, E Leifer, J R Hogness and W Langham. AECU-90 (LADC-566) nd 4p

The above compounds were synthesized with C^{14} in the carboxyl group. Two groups of animals, each consisting of nine female mice (CF-1 strain), were used for the experiment. The mice in one group were each injected intraperitoneally with 0.5 mg of anthranilic (o-amino benzoic) acid. The animals in the other group were injected with 0.5 mg of p-aminobenzoic acid each. During the first 24 hour period, 82.9 per cent of the C^{14} radioactivity, injected as anthranilic acid was recovered in the urine. 3.8 per cent of the C^{14} was found in the exhaled CO_2 indicating that the compound was decarboxylated by the animal. 3.1 per cent of the injected dose was recovered from the feces. The results in the case of p-aminobenzoic acid differ from those obtained for o-aminobenzoic acid in only one essential respect. Only 0.07 per cent of the radioactivity in the original injected dose was recovered in the exhaled CO_2. No activity in either case was detected in any of the tissues after 24 hours.

CERAMICS AND REFRACTORIES

902 An Intermediate Compound in the System $BeO{\cdot}Al_2O_3$ (Chrysoberyl)-Al_2O_3 (Corundum) by Wilfrid R Foster and Herbert F Royal J Amer Ceram Soc 32 26-34 (1949) Jan 1

The results of studies in the High-alumina portion of the system $BeO-Al_2O_3$ do not agree with those of previous workers. An X-ray study of sintered and fused mixtures in this portion of the system indicates the existence of a hitherto unrecognized compound intermediate between chrysoberyl ($BeO\cdot Al_2O_3$) and corundum (Al_2O_3) and possessing the probable formula $BeO\cdot 3Al_2O_3$. The new compound is optically almost identical with chrysoberyl but gives a decidedly different X-ray pattern. Discussion and criticism of earlier work are presented with the aid of equilibrium diagrams.

903 Recrystallization of Beryllium Oxide Bodies at 2000°C. by Pol Duwez, Francis Odell and Jack L Taylor J Amer Ceram Soc 32 1-9 (1949) Jan 1

Recrystallization is an important factor in the preparation of very dense pure oxide ceramic bodies. The work described in this paper shows the effect of the original particle size on the degree of recrystallization of beryllium oxide bodies. A water elutriator for particle-size separation in the subsieve range and an oxyacetylene furnace with zirconia refractories for operation at 2000°C. are described. The microscopic examination of prepared thin sections and the X-ray diffraction back-reflection method are used to determine particle sizes and the degree of recrystallization. Shrinkage during firing is found to be approximately constant for all particle sizes originally below 10 microns and decreases in a regular manner with increasing particle size. The recrystallization factor for beryllium oxide is found to vary from 40 for 1.25-micron particles to 2.5 for 10-micron particles.

CHEMISTRY, ANALYTICAL

904 Chromatographic Separations by Harold H Strain Analyt Chem 21 75-81 (1949) Jan

The developments during the past 5 years in the field of chromatographic separations are reviewed. A table is given listing the substances separated or isolated and the absorbents employed. 152 references.

905 Inorganic Gravimetric Analysis by F E Beamish Analyt Chem 21 144-160 (1949) Jan

This article contains sections reviewing the progress made during recent years in the analyses for beryllium, the rare earth elements, naturally radioactive elements, vanadium, gallium, indium, thallium, germanium, and thorium. 362 references.

906 Ion Exchange by Robert Kunin Analyt Chem 21 87-96 (1949) Jan

The developments during the past 5 years in the field of ion exchange are reviewed. Rare earths separations and apparatus and technique are emphasized. 54 references.

CHEMISTRY, GENERAL

907 Preparation of Radioactive CO_2 from $BaCO_3$ by Norman Zwiebel, John Turkevich and W W Miller. AECU-72 (BNL) nd 2p

Ways to obtain the C^*O_2 from BaC^*O_3 either for introduction into a reaction system for synthesis of a labeled compound, or for transfer to a gas activity measuring device such as an ionization chamber or gas counter are considered. A convenient reaction is a metathetic one producing a thermally unstable carbonate such as the reaction between $BaCO_3$ and $PbCl_2$. Lead chloride was used because it can be readily obtained in anhydrous state, and has a low melting point and vapor pressure. Silver chloride can also be used. To obtain the total CO_2 from a $BaCO_3$ sample two procedures have been worked out. The details are included.

908 Micro Syntheses with Tracer Elements. II. The Synthesis of Anthranilic Acid Tagged with C^{14} by Arthur Murray III and A R Ronzio. AECU-85 (LADC-581) nd 2p Proposed for publication in J Amer Chem Soc

In the course of the investigation of the synthesis of tryptophane from anthranilic acid by living organisms, and also the study of the metabolism of anthranilic acid in the rat, a sample of anthranilic acid tagged with C^{14} was desired. o-Bromoacetanilide is reacted with butyl lithium in an atmosphere of N_2. Carbonation is achieved with $C^{14}O_2$. The reaction mixture, after hydrolysis, is extracted with ether. 55.2 mg of anthranilic acid was produced from 428 mg of o-bromoacetanilide.

909 Micro Syntheses with Tracer Elements. III. The Synthesis of Nembutal Labeled with C^{14} by Arthur Murray III and A R Ronzio. AECU-86 (LADC-582) nd 2p Proposed for publication in J Amer Chem Soc

A small quantity of nembutal was desired for the purpose of a pharmacologic study. Sodium ethoxide was added to ethyl-(2-amyl)-malonic ester. This was quickly followed by the addition of urea tagged with C^{14}. The resulting barbiturate was extracted from acid solution with ether, and purified by recrystallization. It was then converted to sodium pentabarbital with $NaHCO_3$. Yield was 70%.

910 Micro Syntheses with Tracer Elements. IV. The Preparation of Nicotinamide Labeled with C^{14} by Arthur Murray III and A R Ronzio. AECU-87 (LADC-583) nd 3p Proposed for publication in J Amer Chem Soc

Nicotinamide is sometimes preferred to nicotinic acid in metabolism studies. Accordingly, a method for the conversion of nicotinic acid labeled with C^{14} into nicotinamide has been developed. Procedure includes refluxing the radioactive nicotinic acid with thionyl chloride to give nicotinoyl hydrochloride, addition of anhydrous ammonia and filtering, addition of HCl and extraction, neutralizing with KOH and further extraction with ethyl acetate.

COSMIC RADIATION AND MESONS

911 Average Lifetime of π-Mesons and the Capture of μ-Mesons by Nuclei (Sur la vie moyenne des mésons π et la capture des mésons μ par les noyaux) by Bernard d'Espagnat Compt Rend 227 1343-1345 (1948) Dec 20 (In French)

The recent experimental findings seem to favor the hypothesis that the π-meson alone is responsible for nuclear forces; it should therefore be endowed with an entire spin. In order to explain the low probability of the capture of negative μ-mesons by nuclei, this capture could be considered a secondary phenomenon, the μ-meson having spin 1/2. On these assumptions, expressions are found both for the average lifetime of a π-meson, and for the average time of a μ-meson capture. The ratio between these two quantities is then found to be approximately equal to 0.01, which is close to the experimentally found value (the average lifetime of π disintegrating into μ is known to be of the order 10^{-8} sec; the average lifetime of capture of negative μ by nuclei of low Z is 10^{-6}.

912 Cloud-Chamber Evidence of a Meson-Nucleus Interaction by G E Valley, C P Leavitt and J A Vitale Phys Rev 75 201-203 (1949) Jan 1 (Letter to the editor)

Cloud chamber tracks, photographed using a chamber filled with argon at 105 atmospheres of pressure (at 15°C) in a magnetic field of 8800 gauss and at an altitude of 12,730 feet above sea level, have been attributed to sigma-mesons. A typical long, scattered track of this type, ending in a short straight section which makes a large angle with the original direction, is indicated on the photograph shown. Theoretical calculations for the mass of the "long" component in terms of scattering angle are compared with the range-scattering angle data taken, and it is concluded that locally produced and, hence, heavy mesons are responsible for the long portion of the tracks. The short portion is assumed to be produced by a nucleon or heavier particle since none of the data seem to indicate the motion of electrons at the end of the short tracks.

913 Energy of the Disintegration Product of a Light Mesotron by J C Fletcher and H K Forster Phys Rev 75 204-205 (1949) Jan 1 (Letter to the editor)

In a series of cloud-chamber observations performed at sea level, a photograph was obtained which is interpreted as the disintegration of a negative mesotron which comes to rest in a graphite plate. The experiments were performed with an Argon-filled cloud chamber in a magnetic field of 4700 gauss. A diagram of the apparatus and the cloud chamber photograph are shown. Interpretation of the event as the disintegration of a light mesotron leads to a value of 36 ± 3 Mev for the energy of the disintegration particle. This value for the energy is somewhat smaller than the average value of 45 Mev found by Thompson (Physical Review 74 490 (1948)) and considerably larger than the value of 25 Mev found by Anderson et al. (Anderson, Adams, Lloyd, and Rau, Physical Review 72 724 (1947)). The spread in disintegration energies indicates that more than 2 particles are created in the process of disintegration of the light mesotron.

914 The Meson Yield from the Bombardment of Light Nuclei with α-Particles (Die Mesonenausbeute beim Beschuss von leichten Kernen mit α-Teilchen) by Heinz Koppe Z Naturforsch 3a 251-252 (1948) April (In German)

The author has given a method whereby the yield of mesons may be estimated in the bombardment of light nuclei with α-particles of 380 Mev. Assuming that the energy of the α-particle energy is equally distributed on the intermediate and calculating the temperature of the intermediate nucleus, the value arrived at is 1.7×10^{-4}.

915 Observations on Large Cosmic-Ray Bursts at an Altitude of 3500 Meters by Edward F Fahy and Marcel Schein Phys Rev 75 207-208 (1949) Jan 1 (Letter to the editor)

Experiments on the frequency as a function of the size of large cosmic ray bursts under great thicknesses of lead have been carried out at an altitude of 3500 meters. An ionization chamber filled to a pressure of 50 atmospheres of pure argon and surrounded by lead shields was used. Curves obtained using a coincidence arrangement of several G-M counters are shown. It was found that less than 5% of the bursts were caused by air showers, even with the shield. For burst sizes of more than

COSMIC RADIATION AND MESONS (continued)

300 particles, corresponding to an energy of 4.5×10^{10} ev of the burst producing radiation, [Christy and Kusaka Phys Rev 59 414 (1941)], there was a decrease in frequency by a factor of approximately 6.7 going from 3500 meters to sea level which demonstrates that these large bursts at high altitude are not produced by μ-mesons. The burst producing radiation is absorbed by a factor of 1.52 on increasing the lead shield from 10.7-cm to 26.7-cm Pb. This figure corresponds to a mean free path of 434 g/cm^2 in lead, which is considerably larger than the mean free path of a high energy nucleon which is absorbed according to a cross section equal to the geometrical cross section of a lead nucleus which can be estimated to correspond to a mean free path of about 160 g/cm^2 in lead. Some information obtained regarding the zenith angle dependence of the intensity per steradian of the burst producing radiation is discussed.

INSTRUMENTS

916 A Device for Producing an Easily Identified Area on the Electron Microscope Specimen Screen by F W Bishop. AECU-63 (U R) nd 5p

A device for marking electron microscope specimen screens is described which facilitates the relocation of fields in the electron microscopes and provides for similar study with the optical microscope. The appliance consists of a needle mounted so that it pierces the wire mesh specimen screen or Lectromesh screen to mark a particular point or area for future reference. Other accessories are mentioned.

917 Magnetic Influence on Portable Instruments by A E Peterson Electrical Engineering 67 1160 (1948) December

The performance of electric instruments in magnetic fields has been studied with reference to portable voltmeters, ammeters, and wattmeters, and a brief survey of certain items of laboratory equipment which produce magnetic fields which might affect nearby instruments has been made. Curves are shown of the maximum per cent full scale variation produced as a function of magnetic field strength (maximum effect) for both moving-iron instruments and permanent-magnet moving-coil instruments in the 0-10 gauss range. For 5-gauss fields most of the shielded electrodynamic instruments and all of the moving-iron a-c instruments showed effects which were greater than the manufacturer's stated accuracy. Only the larger of the adjustable-ratio autotransformers (0.5-7.0 Kva), certain voltage regulating transformers, and the larger rotating machines, of those tested, were found to produce external fields which affected nearby instruments.

918 A New Source of Electrons and its Inversion as a Source of Ions (Une nouvelle source d'électrons et son inversion comme source d'ions) by P Lorrain Helv Phys Acta 21 497-498 (1948) (In French)

Citing a paper by Keller [Helv Phys Acta 21 170 (1948)] on a new electron and ion source of the Penning type [Physica 4 71 (1937)], the author refers to his own description of a similar instrument [Can J Research 25A 338 (1947)] with magnesium cathodes, working at 200-300 volts with hydrogen at a pressure of a few microns Hg; the intensity of the ion stream is a few milliamp. Another kind of a cold cathode discharge is mentioned which consists of two concentric cylindrical electrodes; in a magnetic field the electrons describe very long cycloidal paths.

ISOTOPES

919 The Relative Reaction Velocities of Isotopic Molecules by Jacob Bigeleisen. AECU-75 (BNL) nd 10p Proposed for publication in J Chem Phys

Among the interesting and important chemical differences between two isotopic atoms or molecules is their difference in reaction rates. The rate constants for competitive reactions of isotopic molecules are considered from the theory of "absolute rates" and the collision theory. Formulae are derived for the ratio of the rate constants and the difference in the activation energies for reactions of isotopic molecules. The difficulties in the a priori calculation of relative rates are pointed

ISOTOPES (continued)

out and discussed. In general the rate constant for the light molecule will be greater than that of the heavy molecule. It is shown that the maximum ratio in the rates occurs when the isotopic atom is essentially free in activated complex. The conditions for the rate constant of the heavy molecule to exceed that of the light one are formulated. It is shown that the difference in activation energies covers the range from zero to the differences in the difference in the zero point energies of the reacting molecules and their respective activated complexes.

920 An Effect of Isotopic Mass on the Rate of a Reaction Involving the Carbon-Carbon Bond by Peter E Yankwich and Melvin Calvin J Chem Phys 17 109-110 (1949) Jan (Letter to the editor)

This article is based on AECD-2293. An abstract of this document has been listed in Nuclear Science Abstracts 1 as abstract No. I-1213.

921 Frequency of Atoms and Structural Periods in the Nuclear Constitution by Richard A Sonder Schweiz Mineralog Petro Mitt 28 528-539 (1948) (In German with English summary)

The calculation of the abundance of the elements and some periodic functions involving the relationship between the frequency and atomic number are discussed.

922 An Isotopic Abundance Rule by K F Chackett and G R Martin Proc Phys Soc 61 197-198 (1948) Aug (Letter to the editor)

The author comments on a recent discussion by Frank [Proc Phys Soc 60 211 (1948)] in which he notes the following exceptions to the rule that even-odd nuclei have at least one even-even neighbor of greater abundance: Xe^{129}, Sm^{147}, Sm^{149}, Pt^{195}, U^{235}. To this list Ru^{99} is added. It is noted that in the case of Xe^{129} and Ru^{99}, the nuclei are exceptions to the rule mentioned because of the unexpected β-instability of the parent isotopes, rather than to any irregularity on the part of the daughter substances. For the Sm isotopes mentioned and U^{235} the anomaly is attributed to the decrease in the abundances of the neighboring even-even isotopes during geological time. No explanation is advanced for the case of Pt^{195}; however, it is noted that although Ir^{195} has not been reported, this may be because the half-life of Ir^{195} is too short for survival in an appreciable amount and too long to have been observed in the experimental bombardments.

923 Nuclear Morphogenesis by Po-Leon Woo Quart J Sci, Wu-Han Univ 9 49-78 (1948) (In English)

Static models of atomic nuclei which are in agreement with the chemical picture of the stable atom have been constructed for the isotopes of both light and heavy elements. The models were constructed on on the basis of the following assumptions: (1) a neutron consists of a proton having an internal electron, i.e., it is mechanically single but electrically double; (2) the potential function is assumed to be $V = [\epsilon \pm e^2/(r - r_0)^K - 1]K$, where K and r_0 are the well depth and the barrier width (sum of the radii) of the interacting particles, respectively, and r is the distance between two particular interacting particles. The author claims a systematic correlation has been obtained for most nuclei represented in this manner and having their masses approximately evaluated.

ISOTOPES SEPARATION METHODS

924 Isotope Concentration by Electrolytic Migration in Aqeous Solutions (Zur Isotopenanreicherung durch elektrolytische Überführung in wässrigen Lösungen) by Alfred Klemm Z Naturforsch 3a 127-128 (1948) Feb (In German)

The author has derived a formula giving the connection between the elementary effect $q = i_W/k_W$ and the primary effects thought to be the causes for the isotopic differences of the electrolytic transport velocity: (1) Difference of migration velocities of equally strong hydrated ions. (2) Difference of hydration of ions. (3) Isotopic effect between ions and undissociated molecules. Only the elementary effect may be obtained from the single enrichment experiments. However, it should be possible to vary conditions and to conclude how large the primary effects, provided for in the formula for the elementary effect, are in each case.

ISOTOPES SEPARATION METHODS (continued)

925 Isotope Displacement in the Case of Cadmium by Ion Migration in Molten Cadmium Chloride (Isotopenverschiebung beim Cadmium durch Ionenwanderung in geschmolzenem Cadmiumchlorid) by Alfred Klemm, Heinrich Hintenberger, and Walter Seelmann-Eggebert Z Naturforsch 3a 172-176 (1948) March (Letter to the editor)

The isotope distribution was displaced in favor of the lighter isotopes of Cd at the boundary between LiCl and $CdCl_2$. This was accomplished by electrolytic ion migration of 50 hours duration, with a current density of 5.5 amperes/cm^2 at 630°C, with a separation distance of 13 cm. The separation factor of one of the fractions (47 mg $CdCl_2$) in reference to the natural Cd was 1.046 for a 1% difference in mass. Thus, the factor is 1.5 for the isotopes Cd^{106} and Cd^{116}. The mass effect is $\mu = \ln({}^{i}W/k_W)/\ln({}^{i}m/k_m) = -0.067$, where W is the migration velocity, and m is the mass of the isotope. The author presents sketches of apparatus and experimental data.

MASS SPECTROGRAPHY

926 A Gas Inlet Leak for Mass Spectrometry by E J Harris J Sci Instruments 25 417 (1948) Dec (Letter to the editor)

A gas inlet leak suitable for use with a source pressure of a few centimeters is described and a diagram is shown.

927 Mass Spectrometry by John A Hipple and Martin Shepherd Analyt Chem 21 32-36 (1949) Jan

The authors have reviewed the fundamental developments in the field of mass spectrometry for the past 5 years. Particular attention is paid to the application to isotopes and the study of ionization processes. 176 references.

METALS AND METALLURGY

928 Calculations for Reactions of Chromium, Molybdenum, Titanium, and Tungsten with Oxygen, Nitrogen, Hydrogen, Carbon and Sulfur by J J Ward, J P Ray and S A Herres. Douglas Aircraft Company Report R-108 (Army Air Force Contract) July 19 1948 97p

This report presents information obtained on a study of theoretical applications of physical-chemical data to the determination of conditions for reactions of chromium, molybdenum, titanium, and tungsten with oxygen, nitrogen, hydrogen, carbon, sulfur, and refractory oxides. Practical considerations, including availability and cost, indicate that primary consideration should be given to the metals chromium, molybdenum, titanium, and tungsten as bases for alloys desired to have good strength at elevated temperatures. The strong reactivities of these metals with atmospheric oxygen and nitrogen, with hydrogen and carbon, and with refractory oxides, which are ordinarily used as furnace linings for containing other molten metals, lead to serious problems in producing the metals and in utilizing them for elevated-temperatures services. Although very few direct experimental data are available, it is possible to calculate, by means of basic physical-chemical principles, the conditions under which reactions could occur.

929 Comparative Studies of Gallium Chemistry Bimonthly Report No 9 for the Period October 1 1948 to December 1 1948. University of Illinois nd 15p (NP-593)

During this period the high temperature reactions of gallium (III) oxide with other oxides and nitrates have been studied. The only positive result was obtained by heating a mole-to-mole mixture of strontium nitrate and gallium (III) oxide. The product obtained on heating the above materials gave an x-ray diffraction pattern different from the patterns of the starting materials. An analysis of this powder pattern indicated a cubic lattice with the edge of the unit cube being 9.05 ± 0.05 A. In addition, the compounds gallium (III) perchlorate hexahydrate and gallium (III) bromide have been prepared.

The residue from the photochemical decomposition of thallium (III) oxinate and thallium (I) oxinate are different compounds, as shown by melting point and x-ray diffraction data. Spectrophotometric studies on $CHCl_3$ solutions of thallium (III) oxinate show an intense band with peak at 400-402

METALS AND METALLURGY (continued)

mμ and two weaker bands with peaks at 338 mμ and 328 mμ. The first band appears to be due to the thallium complex. Solutions investigated in this wave length range, have an average specific extinction of 0.0333 ± 0.00036 in the concentration range of 0.2 to 8.0 mg of thallium per liter of $CHCl_3$. The adherence to Beer's Law in this range is excellent.

930 The Equilibrium Diagram: Nickel-Thorium (Das Zustandsbild Nickel-Thorium) by Lore Horn and Christl Bassermann Z Metallkunde 39 272-275 (1948) Sept (In German)

The nickel-thorium equilibrium diagram is given, along with photomicrographs, a schematic representation of the Debye-Scherrer diagrams, and cooling curve data. The diagram was obtained by thermal and X-ray methods. Three eutectics and 5 compounds are indicated, with 3 of the compounds having peritectics. Thorium has a very low solubility in nickel (0.1% at room temperature) and no solubility of nickel and thorium was observed. Melting point maxima are at 44% by weight Th and 79.5% by weight Th and correspond to the compounds Ni_5Th (1530°) and NiTh (1200°). A eutectic between nickel and Ni_5Th exists at 20.5% Th, melting at 1300°. The eutectic between Ni_5Th and NiTh exists at 68.5% Th and melts at 1030°. The third eutectic is at 91% Th, at 1000°, between NiTh and Th.

931 A New Method for the Micro-Determination of Beryllium with Particular Reference to its Determination in Biological Materials by W N Aldridge and H F Liddell Analyst 73 607-613 (1948) Nov

A specific method for the determination of beryllium in the presence of elements normally present in biological materials has been devised. Essentially, the method consists of using two mordant dyes, Naphthochrome Green G (Schultz 851) and Naphthochrome Azurine 2B in solution at pH 12.3. The elements iron and calcium are first removed, whereas aluminum does not interfere at the pH used. The method is not good for bone and other materials containing large amounts of calcium, but is otherwise applicable down to 1μg of beryllium.

932 Photoelectric Effects in Germanium by S Benzer. National Defense Research Committee Report NDRC-14-580 (Purdue Research Foundation) Oct 31 1945 42p

Several types of photoelectric sensitivity in germanium to metal points contacts are described. One type of characteristic, called the photodiode, shows photoconductive effects of great sensitivity, approaching unit quantum efficiency at a wavelength of 13,000 A. U., with a white light sensitivity of several milliamperes per lumen. Photovoltaic effects also occur. A second type of characteristic, called the photopeak, has properties which enable it to be used as a trigger photocell.

933 Preparation and Physical Properties of Porous Nickel by Howard Martens. California Institute of Technology Progress Report No. 4-66 Feb 11 1948 19p (NP-583)

This report covers an investigation of the preparation of porous nickel specimens by powder metallurgy techniques and a study of their physical properties. Two kinds of nickel powder, having slightly different particle size distributions, were investigated. The porous specimens were prepared by mixing the metal powder with a certain amount of ammonium bicarbonate, compacting the mixture at pressures ranging from 60,000 to 10,000 lb/sq in., and sintering in an atmosphere of pure hydrogen at a temperature of 2200°F. The porosity of the specimens after sintering varied from 7 to 45 per cent, depending upon the metal powder, the amount of ammonium bicarbonate, and the compacting pressure. The permeability to gas was determined (published in a previous report).

MINERALOGY AND MINERAL RESOURCES

934 Density Correction in β-ray Assaying of Rock and Mineral Samples by Henry Faul and Geraldine R Sullivan Nucleonics 53-56 (1949) Jan

The β-activity of a number of minerals mixed with uranium, thorium, and potassium in constant proportion has been investigated. The diluents used, in order of decreasing apparent density, were the following: halite, anthracite, kaolin, calcite, quartz, fluorite, olivine, pyrite, barite, sphalerite, magnetite, magnetite-iron powder (50-50 mixture), iron powder, galena, tungsten powder. Data are shown which indicate that the apparent density correction for samples of varying densities is of significant magnitude. It is suggested that a good calibration curve can be obtained by measuring two or three samples of identical radioactive content but widely different density and then interpolating between these points with the aid of the data presented.

NEUTRONS

935 Slowing Down of Neutrons in Polycrystalline Solids by R Gurney. AECD-2449 (ANL-HDY-562) July 14 1947 Decl Jan 18 1949 11p

A discussion of the phenomena of collisions of neutrons with free atoms is presented. Factors involved and results of various types of collisions are indicated. Curves are plotted for the following: relative probabilities for fractional loss of energy, α/E; inelastic cross section per molecule of BeO; elastic and inelastic cross sections for Be metal; mean logarithmic energy loss per collision for beryllium oxide and beryllium metal; inelastic cross section for graphite; and mean logarithmic energy loss per collision for graphite.

936 Neutron Cross Sections of Ag^{107}, Ag^{109}, In^{115}, and I^{127} by G A Linenberger, J A Miskel and E G Segre. AECD-2458 (LADC-433) Jan 3 1946 Decl Jan 24 1949 8p

The ratio of neutron capture cross section to the U^{235} neutron fission cross section has been measured at various energies for Ag^{107}, Ag^{109}, In^{115}, and I^{127}. The beta-activity resulting from (n,γ) reactions in a particular sample of each of these substances, gives a measure of the number of capture processes that take place during a given neutron bombardment. If, in addition, the number of fissions occurring in a known amount of U^{235} is observed during this bombardment with the same neutron flux, then from the fission cross section of U^{235} for the neutrons of the particular energy used, the capture cross sections of the given substances may be obtained. The values reported are based on the fission cross sections of U^{235} that were measured at Los Alamos. This document is a revision and an amplification of MDDC-228.

937 The Equations of Radioactive Transformation in a Neutron Flux by William Rubinson. AECU-61 (BNL) nd 12p Proposed for publication in J Chem Phys

The standard equations of radioactive transformation are generalized to include the case where radioactive nuclei are subject to transformation by neutron absorption in addition to spontaneous decay. The equations are derived by a method which avoids recourse to the formal methods of solving differential equations. A method is pointed out whereby the equation may be written by inspection for the activity of a species which is descended from an ancestral species through a chain of any combination of decays and neutron absorptions. Some problems are solved as illustrations.

938 Further Studies on the Scattering of Neutrons by Protons by L Goldstein. AECU-82 (LADC-576) Aug 23 1948 79p Proposed for publication in Phys Rev

In a previous work (AECD-1835), extensive studies were reported on the semi-empirical neutron-proton interaction model of the square well shape and "central" type. After a rapid review of the different types of neutron-proton (n-p) interactions depending in different ways on the spin and isotopic spin vectors of these nucleons, an introduction is made to a systematic study of the differential and total n-p scattering cross-sections, using well-shaped static central interactions. In the lower energy range (1-7 Mev) it is recognized that the data favor wells with radii smaller than the classical electron radius. In the intermediate neutron energy interval (10-25 Mev), the probable

NEUTRONS (continued)

intervention of smaller well radii, results in leading to a highly symmetric scattering even at those energies. This means that at these relatively high energies, the different types of interactions do not give too different an account of the scattering process. The neutron energy interval extending from 30 Mev upward is much more well suited in helping to decide which type of interaction and what well radii are best adapted to describe the scattering phenomenon.

In this high energy interval, experimental data are available only at 90 Mev energy. An analysis of these results indicates that at no well radii is it possible with any one of the three types of interactions, (neutral, charges, symmetric) to give a fair description of the scattering process. The symmetric interaction with well radii less than 2×10^{-13} cm gives the best account of the data. This result is in agreement with the one obtained in discussing the low energy scattering data, insofar as they all indicate the necessity of well radii considerably smaller than the electron radius. A fair fit of the observed angular distribution of the recoil protons appearing in the collision of 90 Mev neutrons with stationary protons could be obtained by using a linearly superposed ordinary and exchange (charged) interactions, with a slight excess of the latter. However, the total scattering cross-section falls, in this case, below the experimental value.

The report ends with a discussion of the possible improvements in the description of the details of the scattering by including, beside the central n-p interaction, the tensor force also. Preliminary studies indicate that with the narrow central force well, only a wider tensor force well could be used. This double well would then complicate the formalism but should be more successful in accounting for the details of the scattering process at higher energies that the central force alone.

939 Calculation of Some Effective Cross Sections of Beryllium (Berechnung einiger Wirkungsquerschnitte am Beryllium) by Friedrich Schlögl Z Naturforsch 3a 229-240 (1948) April (In German)

A simplified two-body model is developed for the beryllium nucleus, and the effective cross section for the nuclear photoeffect, neutron scattering, and the (n,2n) process is calculated by perturbation formulas up to the maximum radiation energies of several Mev. The results are compared with empirical data and seem to indicate that the calculated values are somewhat small.

940 On the Theory of Slow Neutron Scattering by Free Protons (Zur Theorie der Streuung langsamer Neutronen an freien Protonen) by Erich Rückel Z Naturforsch 3a 134-142 (1948) March (In German)

In the calculation of the scattering cross section of protons in contrast to that of slow neutrons, the spin dependent potential of the form $-A \cdot \exp(-r/a)$ is considered. Good agreement is obtained with the new experimental values for the scattering cross section value between 0.035 to approximately 2 Mev. This is obtained by taking the values $a = 2.18 \times 10^{-13}$ cm, $A_t = 32.1$ Mev for the ^3S, and $A_s = 10.2$ Mev for the ^1S, which value corresponds to a virtual ^1S state. The result speaks against the existence of a real ^1S state, even though it is impossible here to decide between the two possibilities: virtual or real ^1S state. As limiting value of the scattering cross section for disappearing neutron energy, 20.6×10^{-24} cm^2 is obtained. Furthermore, the calculation for a right angled potential well is carried through and it is proven that the formula found in the literature is incorrect. The correct formula is given. A virtual ^1S state with an energy of 1.5 Mev is obtained in contrast to the values given to date, which should be between 60 and 120 Kev. With correct calculation, they obtain, when the ^1S state is virtual, a ratio of the ^3S to the ^1S of approximately 3:2.

941 Scattering and Absorption of Neutrons by Polarized Nuclei by M E Rose Phys Rev 75 213-214 (1949) Jan 1 (Letter to the editor)

This article is based on AECD-2183. An abstract of this document has been listed in Nuclear Science Abstracts as abstract No. I-977.

NUCLEAR PROPERTIES

942 Note on the Spins of Nuclei of Mass Number Ten by M Goldhaber. AECU-70 (BNL) Sept 9 1948 3p

An article based on this document was published in Phys Rev 74 1194 (1948) Nov 1. An abstract of the article appeared in Nuclear Science Abstracts as Abstract No. I-1887.

943 Erratum: Nuclear Spins and Quadrupole Moments of B^{10} and B^{11} by Walter Gordy and Harold Ring Phys Rev 75 208 (1949) Jan 1 (Letter to the editor) (See NSA No. 1890)

In the above letter the nuclear quadrupole couplings of B^{10} and B^{11} in borine carbonyl were erroneously listed with negative signs. These constants are both positive.

944 Groups of Particles of Limited Penetrability. Application to the Study of Surface and Interface Force Fields. (Ensembles de Particules a Pénétrabilité Limitée. Application a l'Etude des Champs de Forces Superficiels et Interfaciaux) by Roger Mérigoux J Phys et Radium 9 236-244 (1948) July Aug Sept. (In French)

Groups are defined as particles which attract each other if the distance r from the centers is greater than r_0; and repel each other when the distance is less than r_0. It is assumed that r has an average lower limit, r_1. The internal pressure of these groups is calculated directly as a function of r_1. This must become negative if the penetrability of the particles increases. A density variation was found to result in a force field, i.e., the surface energy of these groups was calculated as a function of r_1 and can change sign if r_1 diminishes. The surface and interface force fields were particularly studied as functions of r_1, and the increase in the penetrability of the particles can result in its reversal. The tendency of the particles to migrate can be changed (anamigmatism).

945 Paramagnetic Resonance Absorption in Two Sulfates of Copper by Robert D Arnold and Arthur F Kip. MIT Research Laboratory of Electronics Technical Report No. 61 Nov 1 1948 16p (NP-578)

Resonance absorption measurements in $CuSO_4 \cdot 5H_2O$ and $CuK_2(SO_4)_2 \cdot 6H_2O$ exhibit dissimilarities caused by different degrees of exchange coupling between paramagnetic ions. In the single salt, in which the ions are more closely spaced, exchange coupling causes the absorption lines to be much narrower than would be predicted on the basis of ordinary magnetic dipolar broadening, and causes the appearance of a single line in cases where two lines should otherwise be found. Neither of these effects is observed in the double salt.

946 Tensor Forces and the Neutron-Proton Interaction by Daphne G Padfield Nature 163 22 (1949) Jan 1

The preliminary results of some calculations on the binding energy, quadrupole moment and magnetic moment of the deuteron are given in tabular form. The work closely follows the classical calculations of Rarita and Schwinger [Phys Rev 59 436 (1941)], except that the ordinary and tensor force ranges are not assumed to be equal and neither is restricted to 2.8×10^{-13} cm. A differential analyzer was used in making the calculations. Some of the values obtained are compared with those obtained by Rarita and Schwinger.

NUCLEAR TRANSFORMATION

947 Some Excitation Functions of Bismuth by E L Kelly and E Segre. AECU-88 (UCRL-207) Nov 10 1948 23p (See also MDDC-1145)

The method used in the present work is the stacked foil technique with some improvement in the definition of the energy and the measurement of the beam current. A stack of aluminum foils, each having a thin film of evaporated bismuth on one side, was exposed to the collimated beam of the Crocker 60" cyclotron. The stack was not thick enough to stop the beam which was caught in a Faraday cup, amplified, and fed into a recording milliammeter. The mean range of the cyclotron

NUCLEAR TRANSFORMATION (continued)

beam was found by determining the amount of aluminum absorber required to reduce the beam intensity to one half. The activity induced in the bismuth films was counted by means of a parallel plate ionization chamber. A schematic diagram of the apparatus used for the bombardments is shown. Tabular data give the final results, i.e., the cross sections for the various processes as a function of the energy of the bombarding deuteron or alpha particle. Bi(α,2n) and Bi(α,3n), Bi(d,p), Bi(d,n), and Bi(d,3n), excitation functions were observed. Existence of At^{210} is discussed. This document is a revision and amplification of MDDC-1145.

948 Differential D(d,n)He^3 Cross Section over Entire Angular Range for 10-Mev Bombarding Energy by K W Erickson, J L Fowler and E J Stovall Jr. AECU-89 (AD-11) nd 19p

This reaction was produced in a thin gas target by the focused deuteron beam from the Los Alamos cyclotron. He^3 particles, emitted at the lab angles from 16 deg. to 40 deg. (to the direction of the beam) were detected by a proportional counter. Resulting pulses were analyzed with a ten channel amplitude discriminator. The deuteron beam current was measured by means of a Faraday cup and current integrator. The accuracy of these current measurements was checked by determining the temperature rise of a copper block placed in the beam. Several improvements in equipment and technique were made which permitted considerably better resolution of the He^3 peak than had previously been reported. These included better angular definition of the beam, the use of deuterium gas of higher purity in the target, the use of a counter of improved design, and the installation of remote control absorber system in front of the counter. The energy of the deuteron beam was measured by magnetic deflection immediately after the data for each angular point was taken. The results were corrected to 10.3 Mev deuteron energy. The differential cross section at 90 deg. (center of mass) is found to be 4.5×10^{-27} cm^2. It decreases to a minimum of 2.2×10^{-27} cm^2 at about 45 deg. and then rises steeply for lower angles. The neutron yield emitted by this reaction in the vicinity of zero deg. was determined by use of Cu^{63}(n,2n)Cu^{62} detectors. This gives the D(d,n)He^3 cross section in terms of the 10 min. activation cross section of Cu^{63}, which in turn was estimated from results of several unpublished measurements made at Los Alamos. By this method the differential cross section of D(d,n)He^3 reaction at zero deg. is found to be about five times that at 90 deg. (center of mass).

949 Nuclear Photo-Effect and Isotopic Number by P Jensen Proc Phys Soc 61 579-580 (1948) Dec 1 (Letter to the editor)

The data on the relative (γ,n) cross section as a function of Z, recently published by Wäffler and Hirzel (Helv Phys Acta 21 200 (1948)), are discussed. Further reasons for the sudden rise in the cross section for Z greater than 20 are advanced by the author. The isotopic number, N-Z, has been plotted as a function of Z and a correlation between the isotopic number and the cross section, up to a Z of 40, is noted. The author concludes that the simple consideration of binding energies is not sufficient to account for the correlation observed. To account for the observed parallelism, light nuclei should have a structure which, for other factors being equal, makes them more capable of absorbing the Li γ-rays and (or) emitting neutrons when their neutron excess is greater.

PARTICLE ACCELERATORS

950 A Resonance Effect in the Synchrotron by E D Courant. AECU-76 (BNL) nd 17p Proposed for publication in J Applied Sci

The effect of the resonance occurring at $n = -d(\log H)/d(\log r) = 3/4$ between the second harmonic of the frequency of radial oscillations and the frequency of revolution of the particles in a synchrotron is analyzed. It is shown that this resonance will lead to an increase in the amplitude of the radial oscillations, if the first Fourier co-efficient of the azimuthal inhomogeneities of the magnetic field is too large. The effect may occur even if the value of n at the equilibrium orbit is different from 3/4 because the orbit will drift back and forth periodically due to the phase oxcillations and may cross the place where n = 3/4. A criterion is derived for the condition that the increase in the amplitude of the

PARTICLE ACCELERATORS (continued)

oscillations per unit time due to this resonance be less than the decrease in the amplitude due to the magnetic damping, i.e., that there be a net damping effect. It turns out that this condition reduces to the requirement that the first Fourier component of the azimuthal inhomogeneities of the magnetic field be less than about 10^{-3}. If this condition is not satisfied, the resonance effect will reduce the intensity of the beam unless the equilibrium value of n is sufficiently far from 3/4.

951 Effect of Azimuthal Inhomogeneities in the Magnetic Field of a Betatron or Synchrotron by F K Goward Proc Phys Soc 61 284-293 (1948) Sept 1

Some particular examples of the types of electron oscillation which may be encountered in betatrons and synchrotrons, with special emphasis on the problems of injecting an electron into an inhomogeneous field and of extracting an electron by an applied inhomogeneity, are considered. Azimuthal inhomogeneities in the magnetic field of a betatron or synchrotron cause a forced oscillation of the electron; this forced oscillation may be analyzed into oscillations whose frequencies are simple multiples of the rotational frequency of the electron. The complete motion of the electron may be described by adding to the forced oscillation the normal free oscillation of the electron, the period of which is not, in general, commensurate with the rotational frequency. 9 figures

PHYSICS, GENERAL

952 Calculation of Heats of Adsorption from Adsorption Isoteres by R S Hansen. AECD-2456 nd Decl Jan 25 1949 7p Proposed for publication in J Chem Phys

A thermodynamic derivation of the Clapeyron equation as applied to the calculation of heats of adsorption from adsorption isoteres is given. It is concluded that the derivative dp/dT should be evaluated at constant $\bar{A}$ (total surface of the solid divided by the number of moles surface excess). This is not equivalent to evaluation at constant N/N_m (where N_m is the number of moles adsorbed at saturation) as proposed elsewhere. The commonly used evaluation at constant N should give values equivalent to those obtained by evaluation at constant $\bar{A}$ within experimental error except at surface excesses approaching saturation.

953 Description of Test Equipment and Method of Analysis for Basic Heat Transfer and Flow Friction Tests of High Rating Heat Exchanger Surfaces by W M Kays. Stanford University Technical Report No. 2 (Office of Naval Research Contract) Oct 15 1948 93p (NP-509)

This report is the first of a proposed series of reports on the results of heat transfer and flow friction tests of "high-rating" types of heat exchanger surfaces. A complete description of the project is given along with descriptions of the test apparatus, the method of analysis of data, and a consideration of the experimental accuracy. Included in the appendix is the complete computation procedure and the tables used in conjunction with the procedure. The test apparatus is designed to obtain the $StPr^{2/3}$ and f versus Reynold's number characteristics of heat exchanger surfaces with an overall experimental accuracy of ± 5 per cent. Velocity pressure, and temperature traverses and surveys of the test duct are included as well as the results of a complete test of a louvered-fin type of heat exchanger surface.

PHYSICS, NUCLEAR

954 Revised Draft of Glossary in Terms of Reactor Theory by N M Smith Jr. AECD-2441 (ORNL-84) Nov 4 1948 Decl Jan 19 1949 164p

The glossary of terms used in reactor theory has been compiled as part of a larger glossary of terms used in nuclear energy and engineering, the drafting of which has been sponsored by the Association of Mechanical Engineers. This printing is a first revised draft and is limited to a few copies for declassification purposes and for submission to committee members and referees.

955 Model of Nuclear Structure by C J Milner Nucleonics 56-59 (1949) Jan

A two-dimensional qualitative model of the nuclear structure, which is useful in illustrating some of the elementary properties of nuclei, is described. The model employs floating magnets and is of the type used by Thomson (The Corpuscular Theory of Matter, 110 [Constable, London, 1907]) and attributed by him to Mayer. Small rectangular magnets were used to represent the protons, whereas "soft-iron rods" served as neutron models; both the proton and neutron models were floated in water contained in a nonmagnetic trough. The properties of such a model which are interestingly analogous to those of nuclei are discussed.

956 Nucleonics by Charles L Gordon Analyt Chem 21 96-101 (1949) Jan

This article is a review of the publications of the past 2 years in the field of nucleonics relating to problems of analysis. The paper is divided into various sections, one dealing with procedures, such as tracer methods, induced excitation methods, and differential absorption; one dealing with methods of measuring radiation such as counting and photographic methods; and one dealing with neutron sources and reactions as well as publications on health hazards. 120 references.

PHYSICS, NUCLEAR - METHODS OF MEASURING

957 A Simple Electronic Device for the Measurement of Short Half Lives: The Half Life of Em^{218} by M H Studier. AECD-2445 (CC-3790) Mar 12 1947 Decl Jan 18 1949 14p For publication in NNES

A simple electronic device, consisting of a series combination of a resistor and a condenser, a standard alpha counter, and an oscilloscope, has been devised to measure short half lives. The half life of Em^{218} has been determined as 0.019 sec.

958 Development of a Tissue Radiation Fluorimeter by Benedict Cassen and Lawrence Curtis. AECD-2447 (UCLA-4) Dec 15 1948 Decl Jan 18 1949 7p Proposed for publication in Science

The tissue radiation fluorimeter consists essentially of a small-diameter internally-reflecting light pipe inserted through a hypodermic needle. Light produced from a small amount of material that fluoresces or scintillates on exposure to alpha, beta, gamma, or roentgen rays, is piped through the needle to a photomultiplier tube.

959 Proposed Method for Measuring Scattering of Particle Tracks by S A Goudsmitt and W T Scott. AECU-59 (BNL) Aug 31 1948 5p

An article based on this document was published in Phys Rev 74 1537-1538 (1948) Nov 15. An abstract of the article appeared in Nuclear Science Abstracts as Abstract No. II-214.

960 Decay Times of Scintillations by George B Collins. AECU-60 (BNL) nd 5p

An article based on this document was published in Phys Rev 74 1543-1544 (1948) Nov 15. An abstract of the article appeared in Nuclear Science Abstracts as Abstract No. II-191.

PHYSICS, NUCLEAR - METHODS OF MEASURING (continued)

961 The General Properties of the Parallel Plate Spark Counter I by R W Pidd and Leon Madansky. AECU-62 (BNL) nd 19p Proposed for publication in Phys Rev

A parallel plate spark counter was constructed to provide a uniformly sensitive avalanche volume for the detection of ionizing radiation. It was shown that such a counter avoided the random delay errors inherent in counters with cylindrical geometry and at the same time provided a pulse of several hundred volts with a rise time of 3×10^{-9} sec. Recovery times of the order of 1 millisecond have been obtained with the use of lead and tin cathode materials.

962 Temperature Dependence of Scintillations in Sodium Iodide Crystals by W C Elmore and R Hofstadter. AECU-67 (BNL) nd 5p [See Phys Rev 75 203-204 (1949) Jan 1]

The high speed "Microoscillograph" and a new fast amplifier have been employed in studying the temperature dependence of radium gamma-ray-induced scintillations in thallium-activated sodium iodide crystals. In these studies light pulses were conducted by internal reflection along the length of one-foot transparent fused quartz rod. The crystal sample was placed within a furnace, next to one polished end of the quartz rod. The photomultiplier was kept at room temperature and positioned at the other end of the quartz rod. After transformation of the light pulse to a current pulse, the photomultiplier signal was amplified approximately 200 times and brought to the plates of the Microoscillograph through short leads. Permanent records of the traces are obtained on the target photographic plates of the Microoscillograph. To obtain the records, a ten millicurie source was placed within a few inches of the crystals and random sweeps were used. At the present time the data allow only rough estimates to be made of the duration and pulse shape of the light emitted during a scintillation. This is due to the circumstance that the observed pulses do not show a unique shape or behavior. The results for duration of the light pulse are given.

963 Development of Thick Emulsions by a Two-Bath Method by M Blau and J A DeFelice. AECU-71 (BNL) nd 3p

An article based on this document was published in Phys Rev 74 1198 (1948) Nov 1. An abstract of the article appeared in Nuclear Science Abstracts as Abstract No. I-1872.

964 A New Proton Spectrometer by E M Hafner, W F Donaghue and H Snyder. AECU-74 nd 1p

This document is reproduced below in its entirety.

For the purpose of obtaining accurately focused lines from particle groups produced in nuclear reaction, a new type of focusing geometry has been studied. It consists of a uniform magnetic field covering a half-plane with target for photographic emulsion detector located in the field-free region. A monokinetic group of particles comes to second-order focus at some point on a line on incident energy and the Q of the reaction, after a deflection of about 110°. A group of particles which, as a result of finite recoil of the target nucleous is not homogeneous in energy over the aperture, comes to second order focus at some point on a different line, depending upon masses of the particles involved for the angle of observation. In the case of reactions involving nuclei of mass less than 20, the shift of the focal line with one unit change in mass can easily be observed as a change in the characteristic shape of the focus line. It is therefore best to assign data to a particular isotope and in addition to work with chemically impure targets without ambiguity. Such an instrument should lead to further developments in the technique of nuclear spectrometry. A design which will handle a maximum proton energy of 10 Mev is under way for use with the Brookhaven Van de Graaff.

965 A Proposed Method of Counting Voltage Pulses Less than 0.1 Microsecond Long at a Continuous Rate of More than 10 Mc by Dean A Watkins. AECU-79 (LADC-590) Nov 5 1948 5p

In nuclear studies it is necessary to count voltage pulses originating in a photo tube caused by scintillations in an organic crystal. These pulses are extremely short (less than 0.1 microsecond) and may occur in rapid succession. Present techniques using vacuum tube negative resistance circuits

PHYSICS, NUCLEAR - METHODS OF MEASURING (continued)

cannot be made to operate at frequencies greater than approximately 10 megacycles. An electrostatic beam deflection tube is proposed to provide a decade counter for this purpose. These tubes can be connected in tandem until the counting rate is low enough to operate conventional counting circuits. A drawing of the proposed tube is shown.

966 Action of Charged Particles on Photographic Emulsions (Part V of the Record of the Conference Held in Liege on April 15, 16, and 17, 1948) (Action des Particules Chargées Dans les Emulsions Sensibles V Compte Rendu du Colloque Tenu a Liège les 15, 16 et 17 Avril 1948) by Pierre Cüer Science et Inds Phot 19 441-448 (1948) Dec (In French)

This is a record of 4 papers read at the conference, and of the discussions that followed.

Paper 1. Mechanism of the Action of Ionizing Particles on the Photographic Emulsion--Theoretical Introduction, by A. Hautot. It is shown theoretically that the regression phenomenon leading to the disappearance of the latent image is favored by the smallness of the emulsion grain. Accordingly, for a given emulsion sensitivity, only grains exceeding a certain minimum size will record the ionizing particles.

Paper 2. A Fine-Grain Emulsion for Electrons, by W. F. Berg. Good results were obtained through the use of a new, very fine grained emulsion prepared by Kodak Labs at Harron. These results contradict Hautot's theory.

Paper 3. Effect of Developers and of Chromic Acid on the Latent Image Produced by Charged Particles, by L. Winand. Various developers, (some acting on a superficial latent image only, others capable of reaching an internal latent image), were tested for images produced by α-rays in a certain emulsion. Both developer types recorded particle images. All grains seemed to be very deeply affected, since chromic acid, up to 10% concentration, leaves measurable images.

Paper 4. Some Properties of Emulsions Containing a Borate, by G. P. S. Occhialini. Experiments are cited illustrating the favorable effect of a borate in preventing the fading of particle tracks. New techniques permit, by use of different degrees in development, the establishment of fine discriminations, as, for example, between triton and α in the action of slow neutrons on Li^6. It is found that intense development may give the same results as the presence of a borate.

967 Investigation of Soft Radiations by Proportional Counters--I. by S C Curran, J Angus and A L Cockroft Phil Mag 40 36-52 (1949) Jan

The possibilities of detecting and measuring the energy of soft radiation, particularly β-radiation, γ-radiation and K-capture X-rays, in the range 30 ev. to 150 Kev are discussed and verified experimentally. It is shown that high sensitivity, good resolution and accuracy of energy determination can be obtained through most of this range by combining a suitably designed proportional counter and high gain amplifier of low noise level. The energy required per ion pair formed by electrons of energy between ~200 ev. and 50 Kev is found to be nearly constant for argon and nitrogen gases. The K-capture radiation of Cu^{64} and the γ- and X-radiation emitted by Ra D are analyzed. 13 figures.

968 Investigation of Soft Radiations--II. The Beta Spectrum of Tritium by S C Curran, J Angus and A L Cockroft Phil Mag 40 53-60 (1949) Jan

The proportional counter technique described in a previous paper (Phil Mag 40 36-52 (1949)) has been used to investigate the β-spectrum of tritium in the 0.5-17.9 Kev range. Detailed results near the low energy end and close to the upper limit are presented. The spectrum is shown to be simple and in reasonable agreement with Fermi theory. There is evidence of some deficiency in β-rays of low energy. The best fit with theory is obtained for a neutrino mass $\mu = m/500$ (m = electron rest mass). 6 figures.

PHYSICS, NUCLEAR - METHODS OF MEASURING (continued)

969 Ionization Chamber Technique by N Winogradoff J Sci Instruments 25 432-434 (1948) Dec

Following a brief description of the fundamental structure of ionization chambers, the limitations of the accuracy of radiation intensity measurements, due to the "soaking in" of charge into the insulator, are discussed, and a method of greatly reducing this effect by suitable design of the electrode assembly is described.

970 Measurements of α-particle Energies with the Crystal Fluorescence Counter by I Broser and H Kallmann Nature 163 20-21 (1949) Jan 1

A new method of measuring single particles has been developed which detects and measures the energy of single particles by counting the light quanta produced in fluorescent substances. The method requires little amplification and the reacting material does not have to be enclosed in a vacuum system. Large single crystals of cadmium sulfide which exhibit a brilliant red fluorescence on excitation with α-particles were used. A curve is shown for the light intensity as a function of the energy absorbed for α-particles in a crystal of about 10 mg/sq cm thickness. The average energy per light quantum was determined as 1.7 ev and it was found that the best crystals require 7.7 ev to produce one light quantum.

971 A Multiple γ-ray Counter of Twenty Sections by R W Pringle J Sci Instruments 25 423-424 (1948) Dec (Letter to the editor)

A brief description is given of a multiple Geiger counter which has proved useful in β-γ coincidence measurements and which consists of a number of identical sections working in parallel. One of the features of the design is the use of individual counters with cathodes of square cross section [Curran and Reid Rev Sci Instruments 19 67 (1948)]. A characteristic was obtained for the counters working in parallel which showed a plateau of up to 200 volts with a slope of less than 0.05% per volt. Two such units are suited to counting γ-γ coincidences.

972 On the Possibility of Detecting, in an Inhomogeneous Field, a Spin-Endowed Particle with a Mass Considerably Smaller Than That of an Electron (Sur la possibilité de déceler dans un champ inhomogène une particule douée de spin et de masse beaucoup plus petite que celle de l'électron) by Jean Thibaud Compt Rend 227 1223-1225 (1948) Dec 8 (In French)

The existence of particles lighter than the electrons, either neutral (neutrino) or feebly charged (electrino) has been assumed in the theories of the β-spectrum and of the photon. However, their experimental identification is a difficult problem. The known method [Crane Revs Modern Physics 20 278 (1948)], consisting in the measurement of the momentum of the emitting nucleus, is hardly sufficiently precise for masses inferior to 0.001 that of the electron. The author points out that a very light spin-possessing particle, even if feebly charged, by the very fact of its being light, may have a magnetic moment notably superior to Bohr's magneton. Besides, such a particle, being emitted at a nuclear transformation, must have an energy considerably superior to 1 ev, and should therefore be treated as a relativistic particle. De Broglie has shown [Compt Rend 226 1765 (1948)] that, in these circumstances, the particle's magnetic, or electric, moment can be experimentally determined if the kinetic energy acquired by the particle in the field is less than its initial energy E_0, this latter being $E_0 > 1.2 \times 10^{40} m_0^{3/2}$ (where m_0 is the rest mass). From these considerations, it is shown that a subelectronic particle, in order to be detected in an inhomogeneous field by means of a dipolar effect, should have a mass notably inferior to 10^{-31}-10^{-34} gr., thus approaching that of the largest photon. Its magnetic moment will be larger than Bohr's magneton. Its specific charge will approach or even exceed that of the electron, even if its absolute charge is less than 0.001 that of the electron.

PHYSICS, NUCLEAR - METHODS OF MEASURING (continued)

973 Performance of 931-A Type Multiplier as a Scintillation Counter by G A Morton and J A Mitchell Nucleonics 17-23 (1949) Jan

The characteristics of a 931-A type multiplier tube used as a scintillation counter are discussed. In particular the performance under conditions such that individual, or few, photoelectrons from the cathode contribute to the pulse, and the number distribution of "dark" pulses are treated. Curves are given for the latter as well as for the effects of temperature, shield potentials and cathode-dynode voltage. From the data the author concludes that the following modifications in using such a tube as counter are advisable: 1) using a somewhat higher voltage between the photocathode and the first dynode; 2) operating the tube with a conducting shield around it which is maintained at cathode potential.

974 Photographic Recording of Cathoderay Tube Tracers by R J Hercock. London, Ilford 1947 60p

Two types of cathoderay tube are described: the sealed off and the continuously-evacuated tubes. The former are evacuated and sealed from pumps and are suitable for portable equipment, whereas the latter have cold electrodes in a rarified gas and can record events whose duration is as short as 10^{-9} sec. In this volume there are described the nature of traces; methods of recording (by direct or indirect action of electrons; processing; intensification; and printing and enlarging.

975 Relative Sensitivities of Some Organic Compounds for Scintillation Counters by H T Gittings, R F Taschek, A R Ronzio, E Jones and W J Masilun Phys Rev 75 205-206 (1949) Jan 1 (Letter to the editor)

This article is based on AECD-2353. An abstract of this document has been listed in Nuclear Science Abstracts as abstract I-1646.

976 Two Methods of Measurement of Dead Time in Geiger-Müller Counters by J L Putman and E H Cooke-Yarborough J Sci Instruments 25 409-411 (1948) Dec

The insensitive period following a count in a Geiger counter can be measured by two methods which are described. Each relates only to the periods following fully recovered pulses. The first method is an extension of the oscillograph method of Trost [Z Physik 105 399 (1937)] and of Ruark and Brammer [Phys Rev 52 322 (1937)]. A pulse interval discriminator is described which triggers the oscilloscope only when the counter is in a fully recovered state. This method is accurate for measurements of the dead time of a counter associated with a given recording circuit. By the second method, the time of recovery to any preselected fraction of the full pulse amplitude is measured. This is done by means of an electronic gate which automatically sets its length equal to the recovery time. This period is displayed on a meter. Circuit diagrams are shown.

PHYSICS, THEORETICAL

977 Equations of State of Elements Based on the Generalized Fermi-Thomas Theory by R P Feynman, Nicholas Metropolis and Edward Teller. AECD-2448 (LADC-553) nd Decl Jan 20 1949 43p Proposed for publication in Phys Rev

The Fermi-Thomas statistical model of the atom has been used to derive the equation of state of matter at high pressures and at various temperatures. Calculations have been carried out both without and with the exchange terms. Discussion of similarity transformations lead to the virial theorem and to correlation of solutions for different Z-values.

978 On Feenberg's Perturbation Formula by Herman Feshbach. AECU-58 (BNL) nd 3p

An article based on this document was published in Phys Rev 74 1548-1549 (1948) Nov 15. An abstract of the article appeared in Nuclear Science Abstracts as Abstract No. II-263.

PHYSICS, THEORETICAL (continued)

979 Coefficients of Inner Conversion for Magnetic Multipole Radiation (Koeffizienten der inneren Konversion für magnetische Multipolstrahlung) by R Schafroth Helv Phys Acta 21 499-504 (1948) (In German)

By taking the spin into account, a formula is derived which gives the coefficient of internal conversion with a better approximation than that obtained by other formulas, for example that of Dankoff and Morrison [Phys Rev 55 122 (1939)]. Starting with nonrelativistic wave-mechanical considerations, a transition to Dirac's theory is made (by introducing the perturbation spin correction) in the form of a power expansion of $Z\alpha$, ($\alpha = 2\pi e^2/hc = 1/137$). In this case, the approximation of Dankoff and Morrison is the zero degree term of the expansion which is here continued up to the second degree.

980 The Connection of the Eigen Values of the Heisenberg S Matrix with the Stationary States (Über den Zusammenhang der Eigenwerte der Heisenbergschen S-Matrix mit den stationären Zuständen) by Josef Meixner Z Naturforsch 3a 75-78 (1948) Feb (In German)

A new proof is given for the connection found by Kramers and Heisenberg [Heisenberg Z Naturforsch 1 608 (1946)] between the eigen functions of the continual and discrete spectrum of a wave mechanical eigenvalue problem. This proof is derived from the theory and properties of Green's function.

981 Hydrodynami Exact Solution of Eigenvalue Problems Arising in Connection with the Study of Certain Hydrodynamical or Quantum-Mechanical Wave Phenomena by P Groen Applied Sci Research (Netherlands) 1A 225-236 (1948)

The differential equation $d^2\phi/dx^2 + \{a[\cosh(x/c)]^{-2} + b[\sinh(x/c)]^{-2} - m^2\}\phi = 0$, which is a special case of an equation that is encountered in various physical problems, is solved analytically. The eigenvalue problem which arises when this equation is combined with certain boundary conditions is discussed and solved for various cases.

982 Remarks on the Quantum Theory of Ferromagnetic Resonance (Eine Bemerkung zur Quantentheorie der ferromagnetischen Resonanz) by J. M. Luttinger and C. Kittel Helv Phys Acta 21 480-482 1948 (In German)

It is to be expected that the quantum theory of ferromagnetic resonance yields the same results as the classical theory since the quantum values are extraordinarily large. Still, it might be interesting to show that in quantum mechanical calculations the Eigen values are displaced just as surprisingly by the demagnetization energy. The author shows by use of matrix calculus that in the case of ferromagnetic resonance problems of an ellipsoid neighboring eigen values differ by

$$\Delta E = g\mu_B\left[(H_X + (N_Z - N_X)M_X)(H_X + (N_Y - N_X)M_X)\right]^{\frac{1}{2}}$$

where N_X, N_Y, N_Z are the demagnetization factors and the magnetic field is parallel to the X axis.

RADIATION SICKNESS

983 The Effect of Folic Acid on the Response of the Peripheral Blood and Blood-Forming Tissue of the Rat to Parenterally Administered Strontium^{89} by L O Jacobson, S P Stearner, E L Simmons and M H Block. AECU-78 (ANL-4125 Revised) Oct 1 1948 41p

Female white Sprague-Dawley rats were injected intraperitoneally with a single dose of 4.2 μc/g Sr^{89} and were treated with daily injections of 15 μg folic acid. A group was given only Sr^{89} in a single dose. Hematologic studies were made of the peripheral blood before injection and at 3.6 and 8 weeks after Sr^{89} injection. When the experiment was terminated, all of the surviving animals were autopsied for histologic study. The effects of Sr^{89} on the peripheral blood were closely correlated with the histologic damage observed in the bone marrow and lymphatic tissue. A marked increase in ectopic erythrocytopoiesis, megakaryocytopoiesis, and granulocytopoiesis was evident in the spleens of all Sr^{89}-injected animals. Lymphopoiesis in the white pulp of the spleen was markedly reduced, whereas

RADIATION SICKNESS (continued)

lymphopoiesis in the lymph nodes was only moderately reduced. The cellularity of the thymus in the Sr^{89}-injected animals was likewise only moderately reduced when compared with that of the controls. It is suggested that if the splenic lymphatic atrophy is radiation-induced, then the compensatory phenomenon involving ectopic granulocytopoiesis, erythrocytopoiesis, and megakaryocytopoiesis indicates that lymphopoiesis in the spleen particularly is more susceptible to radiation effect than erythrocytopoiesis, megakarycytopoiesis, or granulocytopoiesis.

984 Effects of Folic Acid on the Anemia Induced by X Irradiation by S Phyllis Stearner Pro Soc Biol and Med 69 518-521 (1948) Dec

This article is based on AECD - 2009-D. An abstract of this document has been listed in Abstracts of Declassified Documents 2 337 (1948) June 30.

985 A Further Survey of Radiation Sickness With Particular Reference to its Treatment by Pyridoxine by L M Shorvon Brit J Radiology 22 49-55 (1949) Jan

The theories advanced to explain the causation of radiation sickness and the remedies recommended are briefly reviewed. The results of the use of pyridoxine in 69 cases are analysed. It is shown to be a reliable, though not infallible, drug in the treatment of radiation sickness. It has also a beneficial effect on X-ray leucopenia and the additional merit of conferring on some patients a sense of general well-being. 45 references.

986 The Surgical Treatment of Irradiation Injuries by Michael L Mason Illinois Med J 95 20-26 (1949) Jan

The 5 large groups into which irradiation injuries of the skin and subcutaneous tissues may be grouped are reviewed. Examples are given of injury treatment which consists in removal of all involved skin and plastic repair of the resultant defect. Additional irritants, particularly irradiation of any sort, must be avoided since they increase the severity of the process and delay surgical repair.

RADIOACTIVITY

987 The Half Life of Protactinium (Pa^{231}) by Q Van Winkle, R G Larson, and L I Katzin. AECD-2446 (ANL-4095) Dec 1947 Decl Jan 18 1949 6p For publication in NNES.

In view of the indirect methods used in previous determinations, and the wide variation in results obtained, a redetermination of the protoactinium half-life has been made through direct determinations of the specific activity with the aid of modern methods for counting alpha particles. A value of $34,300 \pm 300$ years has been found using the formula Pa_2O_5 for the ignited oxide of protoactinium.

988 Electron-Neutrino Correlation in Heavy Elements by M E Rose. AECD-2451 nd Decl Jan 18 1949 1p Proposed for publication in Bull Amer Phys Soc

This document is an abstract; it is reproduced below in its entirety.

The angular distribution of recoil nuclei with respect to the direction of emission of the electron (or positron) in a radioactive decay, provides a means of distinguishing between the various forms for the beta-interaction which have been proposed. Expressed in terms of the angular correlation of electrons and neutrinos, the distribution for allowed transitions is of the form $1 + A \cos \theta$ where θ is the angle between the directions of electron and neutrino [D R Hamilton, Phys Rev 47 456 (1947)], $A = ncp/W$ where p and W are momentum and total energy of the electron. For the Fermi interaction $n = 1$ and for Gamow-Teller, $n = 1/3$. The question arises as to whether the Coulomb field acting on the electron may influence the correlation coefficient (A) sufficiently so that the interpretation of experiments using the free electron values would lead to erroneous conclusions as to the form of interaction. The effect of the Coulomb field has been investigated using approximate wave functions and it is found that in each case (n) is changed by a factor which is the same for all five interaction forms. This factor departs from unity by an amount proportional to Z^2 and for $Z \approx 80$ the correction is only about 20 percent. Therefore, for the purpose of deciding between beta-interaction forms, the influence of the Coulomb field may be neglected.

RADIOACTIVITY (continued)

989 Graphical Representation of the Four Series of Isotopes by K Z Morgan, V K Patterson and F Western. AECD-2459 nd Decl Jan 21 1949 3p

The 4n thorium, 4n + 1 neptunium, 4n + 2 uranium, and 4n + 3 actinium series, respectively, have been delineated.

990 The Radioactive Decay of K^{40} by L B Borst, J J Floyd and C D Coryell. AECU-66 (BNL) July 28 1948 6p

An article based on this document has been published in Phys Rev 74 989-990 (1948) Oct 15. An abstract of this article appeared in Nuclear Science Abstracts as Abstract No. II-635.

991 Long-Lived Metastable State of Te^{125} by G Friedlander, M Goldhaber and G Scharff-Goldhaber. AECU-69 (BNL) Sept 3 1948 4p

An article based on this document was published in Phys Rev 74 981-982 (1948) Oct 15. An abstract of the article appeared in Nuclear Science Abstracts as Abstract No. I-1703.

992 Hf^{175} A New Radioactive Isotope of Hafnium by Geoffrey Wilkinson and Harry G Hicks. AECU-80 (UCRL-233) Nov 29 1948 10p

A new light isotope of hafnium, Hf^{175} has been produced by deuteron and proton bombardments of natural lutecium. Radiation characteristics, half-life, and chemical separations are discussed.

993 Doppler Broadening of a Gamma-Ray Line by V K Rasmussen, C C Lauritsen and T Lauritsen Phys Rev 75 199-200 (1949) Jan 1 (Letter to the editor)

Using a magnetic lens spectrometer with a resolution of 1.47 percent (full width at half-maximum) instead of the 3% used in work previously reported, the secondary electron spectrum from the three gamma rays observed in the deuteron bombardment of beryllium have been re-examined. The secondary electron spectrum obtained is shown. A broadening of 4.1 per cent of the K photoelectron peak is noted which the authors attribute to Doppler broadening caused by the relatively high velocity of the excited Li^7 nucleus. The data obtained are compared with the spectra obtained when the Li^7 is excited by two other means, i.e. the decay of Be^7 and the inelastic scattering of protons in lithium. The results obtained are discussed and possible explanations for the deviations observed are proposed.

994 Gamma Rays and Internal Conversion by J M Cork Nucleonics 24-34 (1949) Jan

Previous studies on internal conversion of gamma radiation, and the methods used, are discussed preliminary to a report of the investigations made by the author. Using a double-focusing magnetic spectrometer in which was incorporated a device enabling the precise comparison of magnetic fields, data on the gamma ray energies of the following elements following neutron bombardment have been obtained and are shown in tabular form: Sc, V. Ag, Cd, In, Te, I, Cs, La, Ce, Pr, Nd, Sm, Eu, Tb, Er, Yb, Hf, Ta, Re, Os, Ir, Au, Bi. An energy level scheme for the W nucleus (after beta-decay of Ta^{182}) is also shown. Some cases in which lines observed were attributed to the photoelectric absorption of a gamma ray in other atoms of the radioactive material are discussed. 14 fig.

995 The Gamma-Rays of W^{187} in the Low Energy Region by Louis A Beach, Charles L Peacock and Roger G Wilkinson Phys Rev 75 211 (1949) Jan 1 (Letter to the editor)

A very thin window G-M counter in a small 180° spectrometer has made it possible to extend a previous study (Physical Review 74 601 (1948)) of W^{187} to energies of about 3 Kev. The electron spectrum in the low energy region is shown: conversion lines were observed at 7, 66, 127, and 136 Kev. These have been associated with two gamma-rays at 0.078 and 0.138 Mev. A tentative decay scheme which is consistent with these data is shown.

RADIOACTIVITY (continued)

996 On the Cs^{137} Disintegration Scheme by Allan C G Mitchell and Charles L Peacock Phys Rev 75 197 (1949) Jan 1 (Letter to the editor)

Recent studies on the beta-decay of Cs^{137} have confirmed that there are no beta-gamma coincidences, i.e. that the one gamma ray emitted is internally converted. [Townsend, Owen, Cleland, Hughes Phys Rev 74 99 (1948)]. The half-life of the Ba^{137} metastable state has been measured as 156 ± 3 sec which is in agreement with the earlier value obtained. From the experimental data the spin change associated with the transition from the metastable state of Ba^{137} to the ground is determined to be $\Delta l = 5$, and the half-life obtained from the Bethe formula [Revs Modern Physics 9 226 (1947)] is consistent with this spin change. The internal conversion coefficient can be calculated as a function of spin change and values for α_k^l, for electric multipole radiation and for β_k^l, for magnetic multipole radiation have been obtained. The best agreement is obtained on the assumption that the radiation is electric 2^5 pole. The difficulties in attempting to draw an energy level diagram showing the spins for each level are discussed.

997 On the Electron Radiation of Ionium (Sur le rayonnement électronique de l'ionium) by Jean Teillac Compt Rend 227 1227-1229 (1948) Dec 8 (In French)

The transformation $_{90}Io^{230} \xrightarrow{\alpha} {}_{88}Ra^{226}$ is accompanied by an emission of γ- and β-rays. A study of the latter radiation with the aid of the Wilson camera showed a ratio of about 1:10 between the number of electrons and that of the α-disintegrations. The energy distribution curve agrees with the calculated positions of the lines L_1, M, and N_1; accordingly, the electron emission should be considered as due to internal conversion of the line γ of 68 Kev. The conversion is large, since the ratio between the number of photons of 68 Kev and that of the α-disintegrations is 1:100 [Curie Compt Rend 227 1225 (1948)]. A small fraction of the observed electrons has a higher energy: it is due to a conversion of the γ-line of 190 Kev.

998 On the γ-Radiation of Ionium (Sur le rayonnement γ de l'ionium) by Irène Curie Compt Rend 227 1225-1227 (1948) Dec 8 (In French)

Following the work of Ward [Proc Cambridge Phil Soc 35 322 (1939)], the γ-radiation of ionium (from an IoTh preparation) was studied with the aid of Ta and W screens, and an aluminum counter. The screen measurements confirmed Ward's findings of two radiations, of 68 Kev and of about 200 Kev. The number of quanta per second of each radiation was determined with the counter, which had been calibrated on certain L lines of radium. The global quanta number of L lines of ionium was also determined. The results were as follows: 0.7 quanta γ of 68 Kev for 100 α-particles; 0.2 quanta γ of 200 Kev for 100 α-particles; 10 quanta L for 100 α-particles. These data, which show an important internal conversion, agree with the findings of Teillac [Compt Rend 227 1227 (1948)], who investigated the β-radiation of ionium. It is the radiation 68 Kev which is highly converted. On the other hand, these results do not agree with the data on the fine structure of ionium found by Rosenblum, Valadarès, and Vial [Compt Rend 227 1088 (1948)].

999 Radiation from Columbium 95 by J E Hudgens Jr and W S Lyon Phys Rev 75 206-207 (1949) Jan 1 (Letter to the editor)

Using a beta-ray spectrometer similar to that described by Deutsch, Elliott, and Evans, [Rev Sci Instruments 15 178 (1944)] both the 35-day and the 90-hour activities Cb^{95} have been investigated. Curves obtained for the beta and conversion-electron spectra are shown along with a Kurie plot of the former. The data obtained are summarized as follows:

	35-day Cb^{95}	90-hour Cb^{95}
β-max.	0.146 ± 0.01 Mev	
γ	0.758 ± 0.02 Mev	0.216 ± 0.01 Mev (100% converted)
$\frac{\text{Conv. electrons}}{\text{Continuous beta-particles}}$	2.4×10^{-3}	1.4×10^{-3}

RADIOACTIVITY (continued)

1000 Short-Lived Halogen Fission Products by Nathan Sugarman J Chem Phys 17 11-25 (1949) Jan

This article is based on MDDC-1566 and AECD-1873. Abstracts of these documents have been listed in Abstracts of Declassified Documents II 39 (1948) Jan 31 and 273 (1948) May 15, respectively.

1001 Some Relations between Dissociation Energies of Light Radioactive Nuclei (Einige Beziehungen zwischen den Zerfallsenergien der leichten radioaktiven Kerne) by Hugo Neuert Z Naturforsch 3a 152-158 (1948) March (In German)

The author shows that, in the range of the light radioactive nuclei (up to about A = 40), some simple relations exist between half lives, dissociation energies and manner of dissociation, nuclear masses, and nuclear spin. If the binding energies of the radioactive nuclei be divided into a half-empirically calculated spin independent and a spin dependent energy part, then it is possible to find from the observed dissociation energies, the spin dependent parts as a function of the nuclear mass. By interpolation and extrapolation, evidences are then obtained from these relations of new or as yet incompletely known nuclei up to A = 40. It is also suggested that the differences between those binding energies that can be calculated and the measured mass defects with the stable nuclei, or the observed dissociation energies of the radioactive nuclei, be regarded as parts of energy of nuclear forces not understood as of the present, primarily probably spin forces.

RADIOGRAPHY

1002 Detail and Survey Radioautographs by W W Wainwright. AECU-92 (AD-16) nd 9p

Radioautographic examination of thin tissue sections (tibia of young rats) is accomplished by two complementary procedures. Survey radioautographs may be obtained by the method of pressing the tissue, which is mounted on a glass microscope slide, in contact with a fast X-ray emulsion. Detail radioautographs for examination at high magnification under high dry and oil-immersion objectives may be obtained by recently announced methods in which the section is mounted directly on a nuclear track emulsion. 21 references.

RADIOTHERAPY

1003 Applications of Artificially Radioactive Isotopes in Therapy I. Cobalt^{60} by William G Myers Amer J Roentgenol and Radium Therapy 60 816-823 (1948) Dec

The author gives a summary of the physical properties of Co^{60} and of his experiences with the isotope. Its advantages in therapy as a supplement to or a substitute for radium and radon are discussed. Because the isotope can be generated readily in any desired quantities and at moderate cost, this method of γ-ray application should become more widely used. For large bone lesions the homogeneous high energy photons are expected to be especially useful in comparison with the heterogeneous γ-rays emitted by radium and its disintegration products because the absorption and scattering will be more uniform. Additional advantages are: (1) There are no gaseous radioactive daughters and leakage is therefore impossible. (2) Because of the properties of alloys containing cobalt which are suitable for irradiation, breakage is almost completely eliminated. Moreover, if it should occur, the pieces could be recovered with no danger of loss by solution and the resultant dangers of lodgment in bones as in the case of radium. If a soluble salt of radiocobalt were present in the broken applicator for some reason, any which did dissolve would be eliminated quickly in the urine. (3) Cobalt alloys can be machined easily to any desired shape before irradiation, thus eliminating the problems and dangers associated with the uniform loading and sealing of radium in applicators. (4) If it proves feasible to prepare needles and other applicators incorporating a permanently attached electro-plated nickel absorber for the soft radiocobalt β-particles, these may then be bent readily to fit lesions of different shapes.

The chief disadvantage of Co^{60} over radium is, obviously, the relatively short half-life of only 5.3 years compared with 1,590 years for radium. For this reason comparisons of relative costs, especially on a long-term basis, are largely meaningless.

RADIOTHERAPY (continued)

1004 Cancer of the Lower Lip by William E Howes and Joseph Rosenstein Amer J Roentgenol 60 763-775 (1948) Dec

From this survey of 112 cases of proved carcinoma at the Brooklyn Cancer Institute the following conclusions are suggested. A strong racial resistance was indicated by the absence of any lip lesion in Negro patients. A study of the histories failed to bring out any other evidence of hereditary influence. The disease is almost entirely limited to the male and by inference it is suggested that the male hormone or some variant of this hormone may be the intrinsic etiological agent while the extrinsic factors can be many. Ultraviolet light is probably the most potent of these. Certainly smoking which is so frequently ascribed as a causative agent can be ruled out as so few lesions originate in the female though there has been a great increase in smoking among women in the last generation. Differential diagnosis is not difficult and with modern methods of biopsy, dark field examination, and so forth, there should be little or no chance of error. The greatest danger lies in those cases where the carcinoma is limited to the depth of the lesion and thus missed in the biopsy specimen.

Accepted modalities of treatment are (1) surgery and (2) radiation. Radiation is subdivided into roentgen and radium therapy, each of which is again subdivided. End results obtained by all forms of treatment are reported in a table.

In the treatment of cervical metastases, end results favor block dissection of the neck. External irradiation alone was shown to be insufficient to control such extension.

Eighty-six of 112 patients (77%) are recorded as having a satisfactory end result, no case being omitted because of extent of lesion. These individuals have been followed up for from 2 to 16 years, averaging 6 plus years. A summary of the cases is given in tabular form.

1005 Complications Following the Use of Low Intensity, Long Radium Element Needles in the Treatment of Cancer of the Cervix Uteri by G W Waterman and E M Tracy Amer J Roentgenol 60 788-794 (1948) Dec

The authors have reviewed a series of 621 cases of cancer of the cervix--1926 to 1941. Four hundred and eighty-nine of these were treated primarily by interstitial irradiation with the long radium element needles. Complications of immediate mortality, fistula formation, urinary and intestinal lesions--not fistulas--and severe inflammatory pelvic reactions have been described as they occurred in this clinic. The incidence of these complications has not exceeded in general that reported by other clinics using other methods. The conclusions reached were that intersititial irradiation by the long radium element needles was relatively a safe method and has not been followed by a high incidence of complications.

1006 Effective Dosage Levels in Interstitial Radium Therapy by Benjamin Jolles Amer J Roentgenol and Radium Therapy 60 745-749 (1948) Dec

A quantitative method of assessing effective tolerance dose levels in interstitial radiotherapy of malignant growths is described. This includes a table of relative effective dosage levels for cylindrical implants. The importance of the perimeter/area ratio in deep roentgen treatments and of the shell/volume ratio in radium therapy is stressed.

1007 Experience with Radioactive Iodine in the Treatment of Hyperthyroidism by George Crile Jr E Perry McCullagh and Otto Glasser Cleveland Clin Quart 16 1-7 (1949) Jan

The results obtained from the treatment by I^{131} of 105 patients with hyperthyroidism during a year's period are reported. The treatment is considered simple, effective, and apparently safe, and does not require hospitalization or supervision of the patient. It is the preferred treatment for elderly patients, for those who are poor surgical risks, and for those with recurrent hyperthyroidism. Although it appears to be an acceptable method of treatment for younger patients with Graves' disease, the final evaluation of its safety in young patients will require many years of observation. It is not recommended for young patients with nodular goiters. Graves' disease hyperthyroidism is controlled in 2 to 4 months by 1 or 2 treatments in 90% of the cases. The remaining 10% may require a third treatment. Diffuse goiters disappear after treatment and the symptoms of hyperthyroidism are as completely and effectively

RADIOTHERAPY (continued)

controlled as by an adequate thyroidectomy. The only complication which has occurred following treatment with I^{131} is a usually transitory hypothyroidism which occurs in about the same proportion of cases as after thyroidectomy. Hyperthroidism associated with nodular goiters is more difficult to control than the hyperthyroidism of Graves' disease and requires larger doses of I^{131} and more treatments. Although nodular goiters become smaller after treatment they do not disappear. 5 references.

1008 An Investigation into Some Factors Affecting X-Ray Dose Distribution and its Measurement by R Oliver and L A W Kemp Brit J Radiology 22 33-43 (1949) Jan

The dose comparator apparatus [Kemp Brit J Radiology 19 233 (1946)] has been used to measure backscatter factor and percentage depth dose for various field sizes at 50 cm and 40 cm F.S.D., using radiation of approaximately 1.0 mm Cu H.V.L. The results are in fairly good agreement with values given by Quimby and Laurence [Radiology 35 138 (1940)], but there are considerable deviations (up to 30%) from the figures given in the Mayneord and Lamerton Survey [Brit J Radiology 14 255 (1941)] for large field areas, the latter giving lower backscatter factors and higher percentage depth dose values at large depths. These deviations are shown to be mainly due to the weight given in the Mayneord and Lamerton Survey to results obtained in wax phantoms. Various factors affecting measurements in a phantom have been investigated. These factors include the effects of phantom material, of using a large ionization chamber, or a chamber with a heavy metal stem, and of applicator construction. A comparison of results with the same applicator used on different X-ray sets is also given. It is concluded that measurements with the dose comparator apparatus are free from any significant errors. 16 references. 7 tables.

1009 Malignant Disease and its Treatment by Radium Vol. 1 by Sir Stanford Cade. 2nd ed. Bristol, England, J Wright 1948 383p

The second edition will be in 4 volumes, of which this, the first, deals with the fundamentals of cancer, and its treatment by radium, covering such subjects as the action of radiation on normal and tumor tissues. There is a new chapter, by Dr. F. G. Spear, on tissue culture and experimental radiology, but on the whole only minor changes have been needed to bring the text up to date. When a book contains the elements of physics and radiopathology and is intended for use by clinicians, it is perhaps unreasonable to complain that radiobiology has not been reconsidered in the light of the more recent work in genetics, biochemistry, and viruses. The present edition closely follows the original, preserving its characteristics as a pioneer textbook in its historical approach, encyclopaedic references, and impressive record of personal observation. In deciding to issue the new edition in 4 volumes the publishers have taken advantage of the author's command of a huge mass of material, while attending, at the same time, to the reader's convenience.

1010 Necrosis of the Brain Due to Radiation Therapy by Joe Pennybacker and Dorothy S Russell J Neurol Neurosurg Psychiat 11 183-198 (1948) Aug

The authors report the clinical and pathological features of 5 cases of necrosis of the brain following radiation therapy by accepted techniques and dosages. The clinical effects may come on suddenly, progress to a point, and become arrested; or they may come on gradually and lead to death. In each case there was a latent period between the radiation treatment and the onset clinical signs of necrosis. The shortest interval was 9 months, the longest 5 years. The pathology of the necrosis appears, to be related to reactions in the smaller blood vessels in which collagenous thickening, fibrinoid necrosis, and thrombosis are conspicuous. As it seems impossible to predict in which cases necrosis will occur, it is suggested that radiation should be reserved for inoperable tumors and those cases in which no further surgical precedures are contemplated.

RADIOTHERAPY (continued)

1011 Postirradiation Ulcerations of the Uterine Cervix by Harold W Jacox Amer J Roentgenol 60 795-797 (1948) Dec

Four cases are discussed in which lesions suggesting a recurrence of malignant growth developed at or near the site of the original cervical carcinoma. Sections of the lesions showed the classical vascular occlusive changes secondary to irradiation and which caused infarction and associated necrosis and ulceration. All the cases occurred in young, thin, colored women and the ulcerations developed approximately 8 months after treatment when the radiation reaction had subsided. Both white and colored patients received equal or larger amounts of radiation during the same period without subsequent complications. It is believed that the vascular apparatus of some individuals is more vulnerable than others or that the ability to form scar tissue is greater in some patients. Fortunately microscopic examination of tissues from the suspected lesions established their true nature and additional damage was avoided by withholding further radiation treatments.

1012 The Preparation of Radon Vaseline Ointment by E L Harrington Amer J Roentgenol 60 836-837 (1948) Dec

A method which seems to offer complete control at every stage without any danger of allowing radon to escape in the preparation of radon ointment for use in the treatment of non-healing radiation ulcers is described.

1013 Treatment of Advanced Cancer Involving the Ear by Charles L Martin and James A Martin Amer J Roentgenol and Radium Therapy 60 750-757 (1948) Dec

Cancer involving the ear receives very poor care in general practice. Techniques of intensive irradiation are described which salvaged half of a series of 35 advanced cases most of which had been treated unsuccessfully elsewhere.

RARE EARTH AND RARE EARTH COMPOUNDS

1014 Radioactive Isotopes of Rare Earths. I. Experimental Techniques and Thulium Isotopes by Geoffrey Wilkinson and Harry G Hicks. AECU-81 (UCRL-253) Dec 14 1948 31p

The experimental techniques used in the chemical separation and identification of radioactive isotopes of the rare earth elements are described. The isotopes are produced by bombardment of rare earth oxides with alpha-particles, deuterons, and protons from the 60 inch Crocker Laboratory cyclotron, and also by bombardment of tantalum with 200 Mev deuterons from the 184-inch cyclotron. The production and properties of three new thulium isotopes are described, Tm^{166} 7.7 ± 0.1 hr, Tm^{167} 9.6 ± 0.1 days and Tm^{168} 85 ± 2 days.

1015 Isotopic Composition and Atomic Weights of Neodymium, Samarium and Tungsten (Die Isotopenzusammensetzung und die Atomgewichte von Neodym, Samarium und Wolfram) by Josef Mattauch and Hildegard Scheld Z Naturforsch 3a 105-114 (1948) Feb (In German)

Using xenon and zinc as gaging elements, the abundance of the different isotopes was measured for the singly and doubly charged ions. The mean results are listed below, along with the % error:

Nd Isotope	142	143	144	145	146	148	150	
% abundance	26.80	12.12	23.91	8.35	17.35	5.78	5.69	
	±0.6%	±0.7%	±0.5%	±0.9%	±0.5%	±1.3%	±1.4%	
Sm Isotope	144	147	148	149	150	152	154	all others
% abundance	2.95	14.62	10.97	13.56	7.27	27.34	23.29	
	±2.3%	±0.8%	±1.0%	±0.9%	±1.4%	±0.9%	±0.8%	< 0.2%
W Isotope	180	182	183	184	186			
% abundance	0.16	26.35	14.32	30.68	28.49			
	±2.4%	±0.3%	±0.8%	±0.4%	±0.3%			

The mean mass numbers are Nd: 144.346 ± 0.010; Sm: 150.508 ± 0.019; W: 183.893 ± 0.003 and the atomic weights are Nd: 144.27 ± 0.01; Sm: 151.43 ± 0.01; W: 183.85 ± 0.01. The data agree well with other recent results, and the authors have shown that impurities of other rare earths down to fractions of a thousandth may be proven and quantitatively estimated.

SCIENTIFIC RESEARCH AND LABORATORIES

1016 Radiochemical Process Development Facilities at Oak Ridge National Laboratory by A Carleton Jealous. AECD-2450 (ORNL) nd Decl Jan 5 1949 2p

This document is an abstract; it is reproduced below in its entirety.

Radiochemical process development at Oak Ridge National Laboratory includes preliminary development and evaluation of new processes on pilot plant scale and the conception and development of fundamentally new techniques for carrying out unit operations and processes. Facilities for such work involve some extraordinary considerations consequent to the handling of radioactive materials. Currently, the past five years experience in a war-built temporary structure is being reviewed and a new, long-term facility is being planned. The general level of radioactivity to be endured in the work area should be one of the first considerations in planning a building for conducting radiochemical process development and associated programs. Having determined the activity level, a general building plan can be prepared and modified by the following factors: flexibility, long-term adaptability, and safety particularly from the radiation hazards viewpoint. The latter factor will largely determine the general space arrangement in order to effect a minimum of traffic within "hot" areas and between "hot" areas and closely associated facilities. The general architecture and the provision of auxiliary service facilities will, of course, be rather dependent upon the requirements of the more basic factors just mentioned. A brief description of present and future development facilities at ORNL is presented.

SPECTROGRAPHY

1017 Molecular Spectra with Ionic Character (Molekülspektren mit Ionencharakter) by K Wieland Helv Phys Acta 21 434-435 (1948) (In German)

All ionic compounds, with the exception of CsF, yield neutral decomposition products and not ions, due to the fact that the separated atoms are in a lower energetic state than the ions. An optical transition between the lower stable ionic curve and a higher, unstable atomic curve, to be observed particularly in absorption, gives rise to prevalently continuous spectra. The case is different for weekly polar or non-polar molecules such as Cl_2 or HCl, where the ground state is lower than the ionic state. No optical transition from a stable ground state of an atomic molecule to a higher ionic state has been observed. It is probable that the higher ionic curves influence the lower atomic curves, whereby the atomic state is depressed and thus stabilized. Thus the atomic state gains in ionic character while the ionic state loses, and instead of an ionic curve one or more atomic curves with ionic character and deep potential wells may be expected. Thus in emission almost continuous band spectra were observed for diatomic molecules or radicals (H_2, I_2, CdX, ZnX, HgX) which were transitions from a higher state with ionic character to a lower normal state, the ground state of the molecule.

TRACER APPLICATIONS - BIOLOGY

1018 Isotopic Studies of Potassium Exchange Rates between Cellular Elements and Plasma of Human and Canine Blood in Vitro by C W Sheppard and W R Martin. AECD-2453 nd Decl Jan 5 1949 1p See also AECD-2249

This document is an abstract; it is reproduced below in its entirety.

Fresh heparinized blood is maintained in an apparently viable state for eight to ten hours in vitro. Hemolysis is generally at, or below, the lower limit of visual detection. Hematocrits are routinely determined and lie within 2 1/2 per cent of the mean. There is some evidence of occasional systematic increases of potassium concentration in the plasma late in the experiments, the total change being about 15 per cent. In human blood the concentration of isotope K^{42} in the plasma decreases fairly rapidly. Equal specific activities of cells and plasma are reached at about 18 hours. The curve is a smooth exponential with a single half value time corresponding to an exchange rate of about 10^{-13} millimol of potassium per hour per cell. In the dog, the curve shows an initial rapid exponential decline to an elevated base line, which slowly declines at about one per cent per hour. Removal of a fraction of the cells containing leukocytes, platelets and probably young erythrocytes, eliminates the rapid exponential phase. The slow decline is evidently characteristic of the exchange of potassium in mature canine erythrocytes, the rate being about 4×10^{-15} per hour per cell.

TRACER APPLICATIONS - BIOLOGY (continued)

1019 The Metabolic Conversion of the Carbon Chain of DL-Lysine-ϵ-C^{14} to L-Arginine in the Dog by L L Miller. AECU-56 (UR) nd 3p

In the course of studies of protein metabolism in the dog using DL-Lysine-C^{14}, the basic amino acids were isolated from protein hydrolysates with the aid of the ion exchange resin IRC-50. The activity found in the ornithine moiety of the arginine indicates that the carbon chain of arginine may be derived from lysine. l-Arginine was isolated as the monoflaviante which was assayed for C^{14} activity, and then twice reprecipitated from solution to which inert L-lysine had been added to "wash out" any possible contamination with L-lysine-ϵ-C^{14}. The specific C^{14} activity was unchanged by this procedure. A portion of the flavianate was assayed for C^{14} activity directly and another portion was freed of flavianic acid by treatment with aqueous barium hydroxide. The resulting arginine in solution was hydrolyzed with barium hydroxide in a sealed tube at 100°. The precipitated barium carbonate was filtered off and the residual solution treated with paratoluene-sulfonyl chloride to yield a crystalline diparatoluenesulfonyl derivative, mp 171-172, which showed no depression of melting point when mixed with an authentic specimen obtained from a similarly degraded specimen of l-arginine.

This finding of the conversion of the carbon chain of lysine to that of arginine is the first identification of an essential amino acid as a metabolic precursor of the carbon chain of arginine (i.e. ornithine) and may represent a major metabolic pathway for the formation of arginine in the absence of dietary arginine, especially when the diet contains only essential amino acids.

1020 The Metabolic Conversion of the Carbon Chain of DL-Lysine-ϵ-C^{14} to L-Glutamic and L-Aspartic Acids in the Dog by L L Miller and W F Bale. AECU-64 (UR) nd 4p

With the aid of the ion exchange resin Amberlite I-R-4, L-glutamic acid was isolated as the hydrochloride and aspartic acid as the copper salt from acid hydrolysates of liver and plasma proteins (as well as from other tissues). Both the glutamic and aspartic acids from liver and plasma proteins have highly significant C^{14} activity when compared with the L-lysine dihydrochloride isolated from the same tissues as shown in tabular form. To assess the role of CO_2 assimilation in this activity, these compounds have been decomposed with ninhydrin under controlled conditions. The data show that not more than 20% of the glutamic acid activity is derived from the α-COOH of glutamic acid. Hence the major locus of activity cannot be referable to CO_2 assimilation. In addition almost all the activity of aspartic acid is released by ninhydrin. This means that whatever aspartic acid is derivable from glutamic acid has no significant activity in the noncarboxyl carbons. Thus, the activity of glutamic acid must reside in the α- or γ-carbons. The α-carbon is extremely unlikely as the locus of this activity and thus leaves the γ-COOH of glutamic acid as the most probable site of C^{14} activity. Because the order of magnitude of activity of glutamic acid and lysine are relatively similar, it appears that the ϵ-carbon of lysine has become the γ-COOH of glutamic acid.

1021 Hemin Synthesis in Rabbit Bone Marrow Homogenates by K I Altman, K Salomon and T R Noonan. AECU-65 (UR) Nov 4 1948 4p

Bone-marrow homogenates were prepared and incubated. The results obtained are presented and indicate that rabbit bone-marrow homogenates can synthesize hemin from methylene-labeled glycine. Using C^{14}-labeled glycine, unequivocal evidence of appreciable protein synthesis in these bone marrow homogenates has been obtained.

1022 The Distribution in Rat Tissues of the Methylene Carbon Atom of Glycine Labeled with C^{14} by Kurt I Altman, George Casarett, Thomas R Noonan and Kurt Salomon. AECU-77 (UR-52) Dec 20 1948 11p

Data on the distribution of the methylene carbon atom of glycine labeled with C^{14} in a variety of rat tissues have been presented in terms of corrected specific activity and percent of total administered C^{14}-activity. Urinary and fecal excretion of C^{14} subsequent to administration of labeled glycine, as well as C^{14}-activity of the gastrointestinal contents have been reported. In two cases data on C^{14}-activity of urea have been presented. The C^{14}-activity of carbon dioxide expired over a period of five hours was measured and found to constitute ca 12% of the total C^{14}-activity administered.

TRACER APPLICATIONS - BIOLOGY (continued)

1023 Metabolism of C^{14} Tagged Urea by Edgar Leifer, Lloyd J Roth and Louis H Hempelmann. AECU-83 (LADC-562) nd 6p Proposed for publication in Science

An article based on this document has been published in Science 108 748 (1948) Dec 31. An abstract of the article appeared in Nuclear Science Abstracts as abstract No. II-669.

1024 The Gross Metabolism of Radioactive Pentobarbitol in Mice by L J Roth, J R Hogness, Edgar Leifer and Wright Langham. AECU-84 (LADC-574) nd 4p Proposed for publication in Science

The synthesis of radioactive urea (C^{14}) of high specific activity permits tracing the metabolism of urea and many readily synthesized derivatives. The universal use of the barbiturates in clinical medicine makes the pharmacological investigation of these compounds of interest. Nembutal (Pentobarbital sodium) (specific activity 8400 c/sec/mg) has been prepared from radioactive urea. The results in mice of a gross metabolism study of this radioactive barbiturate is reported.

1025 The Biologic Decay Periods of Sodium in Normal Man, in Patients with Congestive Heart Failure, and in Patients with the Nephrotic Syndrome as Determined by Na^{22} as the Tracer by Sam Threefoot, George Burch and Paul Reaser J Lab and Clin Med 34 1-13 (1949) Jan

Rates of elimination of sodium were studied with Na^{22} as a tracer in normal man and in man suffering from chronic congestive heart failure or from chronic glomerulonephritis of the nephrotic type. Because of the nature of the experiments, the true biologic half-life period (B 1/2) was not measured directly. Instead, the time necessary to reduce the serum concentration to one-half the initial level after the establishment of equilibrium (C 1/2) and the time required to eliminate one-half the injected Na^{22} in the urine (U 1/2) were determined. C 1/2 values obtained were usually less than the U 1/2 ones. C 1/2 in the control subjects most probably was equal to B 1/2, but this was not likely to be true for the abnormal subjects. C 1/2 and U 1/2 varied considerably with normal physiologic phenomena and with such abnormal states as congestive heart failure, nephrosis, and with administration of drugs, and sodium and water intake. For example, a diet low in salt appeared to lengthen the time of C 1/2 and U 1/2, whereas a diet high in salt was shown to shorten them.

C 1/2 was increased about threefold in patients with chronic congestive heart failure and about fivefold in the presence of the nephrotic syndrome. U 1/2 was increased to an even greater extent by these diseases and was influenced by the progress of the process. When the diseases were aggravated and fluid of edema was accumulating, the influence of dilution modified the C 1/2. The importance of these observations and the relative general significance of B 1/2, C 1/2, and U 1/2 periods in the biologic application of radioelements, particularly radiosodium, have been discussed.

1026 Biological Studies with $Arsenic^{76}$. II. Excretion and Tissue Localization by Howard S Ducoff, William B Neal, Robert L Straube, Leon O Jacobson and Austin M Brues Proc Soc Exptl Biol and Med 69 548-554 (1948) Dec

Arsenic excretion was studied in man, rats, and rabbits. Less than 10% of the excreted arsenic is found in feces in any of these species; rats have by far the slowest rate of excretion. Data are given for arsenic distribution in various organs in man, the rat, the rabbit, and 2 strains of mouse. The degree of individual variation within each species was very great; in contrast to man and to other animals studied, the rat retains most of the injected dose in the blood for a considerable length of time. The ratio of arsenic concentration in kidney, liver, and spleen of healthy inbred mice was found to be fairly constant for a given time after administration, and this ratio is suggested as a criterion for effects of various types of treatment. Using this ratio as criterion, it was found that arsenic distribution is altered by the presence of transplanted tumors. Factors changing arsenic distribution are discussed in relation to effects on levels of sulfhydryl-containing substances.

TRACER APPLICATIONS - BIOLOGY (continued)

1027 The Phosphorus Metabolism of Three Species of Helminthosporium as Determined by Use of Radiophosphorus by R S Davidson Phytopathology 39 6 (1949) Jan

This paper was presented at the 40th annual meeting of the American Phytopathological Society, held at Pittsburgh, Pa., Dec. 6 to 8, 1948.

1028 Proceedings of Twenty-Sixth General Meeting of the International Association for Dental Research, Rochester, N. Y. comp by Hamilton B G Robinson J Dental Research 27 717-782 (1948) Dec

These five papers were presented at the above mentioned meeting: A Preliminary Report on the Fluoride Content of Normal Blood and Urine as Related to the Fluoride Content of Community Water Supplies, by Frank A. Smith and Dwight Gardner; Ionic Exchange as the Mechanism for Ca_{45} Adsorption by Bone, Dentin, and Enamel, by Elizabeth K. Emery, H. C. Hodge, and M. Falkenheim; The Incorporation of Radioactive Carbon in the Skeleton and Teeth of Rats, by W. D. Armstrong, Jack Schubert, and Arthur Lindenbaum; Effect of Atomic Radiation on the Oral Structures, by Joseph L. Bernier; 2nd The Use of the Radioautograph for Studying the Relative Radioactivity of Dental Materials, by Reidar F. Sognnaes and James H. Shaw.

1029 The Response of the Thyroid Gland in Normal Human Subjects to the Administration of Thyrotropin, as Shown by Studies with I^{131} by Malcolm M Stanley and E B Astwood Endocrinology 44 49-60 (1949) Jan

Studies with I^{131} of the effects of a single injection of 15 or 30 milligrams of thyrotropin in 23 normal subjects have been made. For 8 hours after the injection no effect on the rate of iodine uptake by the thyroid could be detected, but thereafter a marked acceleration, becoming maximum in 24 to 48 hours, was observed. The rate of turnover of iodine returned to the pre-injection level in 4 to 5 days. This sequence of events was still more clearly exhibited by individuals whose thyroids had been compensatorily suppressed by thyroid medication. When the organic binding of iodine was prevented by the use of mercaptoimdazole, it could be shown that the iodide-concentrating capacity of the thyroid was similarly increased by thyrotropin and the time relationships of this increase were the same as those of the total iodine accumulation. Following a single injection of thyrotropin, it was not possible to detect any loss of stored thyroid hormone.

1030 Theoretic Considerations of Biologic Decay Rates of Isotopes by George E Burch, Sam A Threefoot and James A Cronvich J Lab and Clin Med 34 14-30 (1949) Jan

Equations have been derived which make it possible to predict the influence of variations of intake and output of a nontracer substance and of the size of its compartment upon the concentration within the organism and elimination from the organism of a tracer substance administered in a single dose. These theoretic considerations demonstrate the extreme importance of controlling and properly evaluating factors which affect the rate of elimination and the size of the compartment of the nontracer substance. The need and reasons for exercising every caution in interpretation of data concerned with measuring variations in concentration and total content of the tracer substance are emphasized.

Although the discussion is chiefly concerned with problems for sodium tracer studies, these theoretic considerations apply to any type of tracer experiments, regardless of size or location of the compartment and regardless of whether the tracer is stable or radioactive. It is hoped that the mathematical considerations will be of value to others engaged in biologic and nonbiologic tracer research.

TRACER APPLICATIONS - PHYSICS

1031 The Thermodynamics of Dilute Silver Halide Solid Solutions by Fred Vaslow and G E Boyd. AECD-2454 nd Decl Jan 18 1949 1p

This document is an abstract; it is reproduced below in its entirety.

The silver halides form a particularly simple system for the quantitative study of the factors involved in the carrying of radioactive tracers. The distribution of silver bromide in silver chloride

TRACER APPLICATIONS - PHYSICS (continued)

in a homogenous solid in equilibrium with an aqueous solution is given by the following equation:

$$\frac{X_{AgBr}\, C_{Cl^-}}{X_{AgCl}\, C_{Br^-}} = \frac{\gamma^2_{\pm HBr} K_{AgCl}}{\gamma^2_{\pm HCl} K_{AgBr}}\, e^{-\Delta F/RT}$$

where X is the mole fraction in the solid, C the molality in the aqueous solution, K the thermodynamic solubility product, and $\gamma\pm$ the mean activity coefficient for the halide salt in aqueous solution. The interaction free energy, ΔF_i may be regarded as the difference between the partial molal free energies of a perfect solid solution and the actual AgBr-AgCl solid solution at the same mole fraction. Values of ΔF_i have been determined from the experimental distribution ratios using 34hr Br^{82} as an analytical tracer and literature values of the other thermodynamic constants. Values of ΔH_i and ΔS_i were obtained from the variation of ΔF_i between 30° and 60°. At 30°, these were 287 cal/mol, −137cal/mol, and −1.4 e.u. for ΔF_i, ΔH_i, and ΔS_i, respectively. The values of ΔF_i were independent of the mole fraction of AgBr from 1.4×10^{-4} to 2×10^{-3} mole fraction which was the upper limit of measurement. Below $X = 1.4 \times 10^{-4}$ to the lower limit at 7×10^{-5} mole fraction the free energy markedly increased.

Preliminary results for AgCl in AgBr and AgCl in TlCl solid solutions gave for ΔF_i, −70 and 8×10^3 calories respectively. Theoretical calculations based on published crystal lattice energies gave values for ΔH_i of −1.0 and 3.6 kcal/mol for AgBr in AgCl and AgCl in AgBr respectively.

1032 Diffusion of Radioactive Copper during Oxidation of Copper Foil by Gilbert W Castellan and Walter J Moore J Chem Phys 17 41-43 (1949) Jan

Strips of copper foil were plated with a thin deposit of radioactive copper and the specimens then oxidized in air at 800°, 900°, 1000°C. From the distribution of radioactive copper in the oxide, diffusion coefficients, D, for cuprous ion in cuprous oxide were calculated. Over the temperature range D was found to be $0.0358 \exp(-37{,}000/RT) cm^2\ sec^{-1}$. The activation energy for the oxidation of copper is 39 ± 2 kcal/mole, so that these measurements provide further evidence that diffusion of Cu^+ in Cu_2O is the rate-determining step in the oxidation.

TRANSURANIC ELEMENTS

1033 Paramagnetic Susceptibilities and Electronic Structures of Aqueous Cations of Elements 92 to 95 by J J Howland and M Calvin. AECD-2440 [UCRL-206 (rev)] Dec 8 1948 Decl Jan 19 1949 21p (See also AECD-1895)

Magnetic susceptibilities per gram atomic weight of elements 92 to 95 in most of their oxidation states were measured at 20°C on 0.1 ml of solution which was 0.005 to 0.09 M in heavy element. The values obtained (all paramagnetic) in e.m.u. x 10^6 were: U(IV), 3690; Np(VI), 2060; Np(V), 4120; Np(IV), 4000; Pu(IV), 1610; Pu(III), 370; Am(III), 720. The results could be interpreted only on the basis of electronic configurations $5f^n$, even though susceptibilities were generally lower than the theoretical values and lower than experimental values for corresponding lanthanide $4f^n$ cations. The lower values should be expected as a result of the Stark effect produced by electric fields of anions and of water dipoles. Failure of the Russell-Saunders approximation to the coupling between electrons may account for some of the error in the theoretical calculations. Wider multiplet splitting in the actinides account for the fact that the susceptibilities of Pu(III) and Am(III) are many-fold lower than those of Sm(III) and Eu(III) respectively. This document is a revision of MDDC-1895. 24 references.

1034 Oxidation Potential of the Pu(III) − Pu(IV) Couple in Perchloric Acid Solution. Heat Content and Entropy Change by R E Connick and W H McVey. AECD-2455 (UCRL-70) Mar 1948 Decl Jan 25 1949 41p

It was expected that the $Pu^{+3} - Pu^{+4}$ potentials in perchloric and in hydrochloric acid would differ principally because of chloride complexing of Pu^{+4} in the hydrochloric acid system. The values of the potentials previously reported in the project literature are inconsistent with this idea. Since it was

TRANSURANIC ELEMENTS (continued)

believed that the measurements in the perchloric acid system were in error, the EMF of the cell: Pt: H_2:1 M $HClO_4$; 1 M $HClO_4$, $Pu(ClO_4)_3$, $Pu(ClO_4)_4$: Au was determined at 25°C. The value of −0.982 volts, which was obtained for the reaction $Pu^{+3} + H^+ = Pu^{+4} + 1/2\ H_2$ in 1 M perchloric acid, differs significantly from the previously reported value and is consistent with the idea that Pu^{+4} is partially complexed by chloride ion in 1 M HCl.

From the data on the disproportionation of Pu^{+4} in 1 M perchloric acid and the $Pu^{+3} - Pu^{+4}$ potential, a formal potential scheme involving the +3, +4, and +6 oxidation states of plutonium was derived. The EMF of the cell was also measured at different temperatures and the change in heat content for the reaction $Pu^{+3} + H^+ = Pu^{+4} + 1/2\ H_2$ was calculated to be +13.52 kcal/mole. This value is to be compared with 11.3 kcal/mole obtained elsewhere from calorimetric measurements. Using the values of ΔH and ΔF obtained for the reaction $Pu^{+3} + H^+ = Pu^{+4} + 1/2\ H_2$, ΔS was calculated to be −31 e.u. at 25°. From an estimated entropy value for Pu^{+3}, the entropy of Pu^{+4} was found to be −77e.u. It was possible to calculate a value of −18 e.u. for PuO_2^{++} from the data on the heat of oxidation of Pu^{+3} to PuO_2^{++}. The entropies of the three oxidation states of plutonium compare very closely with those of uranium.

URANIUM AND URANIUM COMPOUNDS

1035 Spectrophotometric Evidence for the Existence of UCl_5 as the Double Compound $UCl_6.UCl_4$ by C C Sterett and V P Calkins. AECD-2443 (Y-187) Nov 4 1948 Decl Jan 19 1949 12p Proposed for publication in J Amer Chem Soc (See also MDDC-1094)

Spectrophotometric evidence for the existence of uranium pentachloride as a double compound of uranium hexachloride and uranium tetrachloride has been obtained by studying the absorption spectra of these chlorides in carbon tetrachloride and thionyl chloride solutions in the visible and ultraviolet regions of the spectrum. This document is a revision of MDDC-1094.

1036 The Radiation Spectrum of the Transition $U^{233} \rightarrow Th^{229}$ by M H Studier. AECD-2444 (CB-3793) Mar 10 1947 Decl Jan 18 1949 22p For publication in NNES

A complex radiation spectrum consisting of 310 Kev, 80 Kev, and 40 Kev gamma rays, L x-rays, and conversion electrons is shown to be associated with the transition $U^{233} \rightarrow Th^{229}$. The 80 Kev and the 40 Kev gamma rays seem to be largely converted.

1037 Search for Three-Way Fission of U^{238} by 14-Mev Neutrons by L Rosen and R Taschek. AECD-2452 (LADC-542) Sept 25 1947 Decl Jan 18 1949 4p

The photographic technique has been employed to investigate the possibilities of the disintegration of a U^{238} nucleus into three particles of comparable masses when exposed to 14-Mev neutrons. Twenty-four-thousand tracks were analyzed with the conclusion that, if the above event takes place, its cross section is less than 0.00025 that of binary fission.

1038 Determination of the Half-Life of U^{233} by E K Hyde. AECD-2457 (CB-3634) Sept 5 1946 Decl Jan 21 1949 7p

The half-life of the alpha-emitting isotope, U^{233}, has been redetermined to be 1.62 (±0.01) x 10^5 years. The uranium used in the determination was produced by a several-months irradiation of thorium with the neutrons of the uranium-graphite chain-reacting pile at the Clinton Enginneer Works. The nuclear transformations involved may be represented as:

$$Th^{232}\ (n,\gamma)\ Th^{233};\ Th^{233} \xrightarrow{23.5\ min} Pa^{233} \xrightarrow{27.4\ d} U^{233}$$

URANIUM AND URANIUM COMPOUNDS (continued)

1039 Absorption and Luminescence Spectra of Uranyl Salts at Temperatures of Liquid Helium (Spektry Pogloshcheniya i Luminestsentsii Uranilovykh Solei pri Temperature Zhidkogo Geliya) by B N Samoĭlov Zhur Eksptl i Teoret Fiz 18 1030-1040 (1948) Nov (In Russian)

Absorption and luminescence spectra of the following uranyl salts were investigated at 4.2°K: potassium uranyl sulfate, uranyl sulfate, uranyl chloride, uranyl acetate, and sodium uranyl acetate. The results are given in detailed tables and photographs of spectra. At the temperature of liquid air a preliminary study was made of the polarization properties of uranyl acetate and sodium uranyl acetate. Although belonging to the isometric crystallographic system, the latter salt showed some remarkable polarization phenomena, viz, the circular polarization observed on certain lines of the luminescence spectrum, and the circular dichroism of two lines of the absorption spectrum.

1040 The Crystal Structure of Barium Uranate. Nonexistence of the UO_4 Group (Die kristallstruktur des bariumuranates. Nichtexistenz der UO_4-gruppe) by Sten Samson and Lars Gunnar Sillen Arkiv Kemi, Mineral och Geol 25A No. 21 1-16 (1948) (In German)

The diagram of the structure is derived. To each U atom there belong 2 O atoms which are not shared by any other U atom. These form the uranyl group UO_2^{++}. Moreover each U atom shares 4 O atoms with 4 other U atoms. U and O form octahedrons which are joined in networks in the y and z directions. Between these networks (which are vertical to the x direction) the layers of Ba atoms are located.

1041 The Formation of U^{232} by Helium Ions on Thorium by Amos S Newton Phys Rev 75 209-211 (1949) Jan 1 (Letter to the editor)

This article is based on AECD-2081. An abstract of this document has been listed in Nuclear Science Abstracts as Abstract I-301.

1042 A New Preparation of Uranium Oxide UO_3 and a Study of its Decomposition (Nouvelle préparation de l'oxyde d'uranium UO_3 et étude de sa décomposition) by André Boullé and Marthe Dominé-Bergès Compt Rend 227 1365-1367 (1948) Dec 20 (In French)

Very pure hydrated uranium oxide was obtained electrolytically from a 10% solution of uranyl nitrate, by the method described by Jolibois [Compt Rend 215 319 (1942)]. It loses water, in air, at 380-390°. At higher temperatures UO_3 is transformed into U_3O_8. This reaction was studied with the aid of a thermo-balance which showed a two-step loss of weight: 0.61% at 520°, and 1.27% at 610°. The existence of an intermediary state, stable between these temperatures, was confirmed by a simultaneously carried out thermal analysis which showed changes in structure at the same temperature points; (UO_3 is amorphous, the two other stages are crystalline). X-ray spectra, taken with copper Kα radiation, furnished further confirmation. The intermediate stage is best interpreted as a solid solution corresponding to an approximate composition $UO_{2.90}$.

1043 Uranium Hydride - I by F H Spedding, A S Newton, J C Warf, O Johnson, R W Nottorf, I B Johns and A H Daane Nucleonics 4-15 (1949) Jan

This article is based on MDDC-1585. An abstract of this document has been listed in Abstracts of Declassified Documents II 53 (1948) Jan 31.

VACUUM SYSTEMS

1044 A Single-stage Vapour Vacuum Pump by J Pollard, R W Sutton and P Alexander J Sci Instruments 25 401-403 (1948) Dec

The principles of the design and details of the construction of a single-stage glycerol vapor pump of 3 in. diameter are described. The pump, which is made of glass, has a maximum speed of 80 liters/sec. The range of pressure over which it performs satisfactorily and its backing pressure requirements compare favorably with two- and three-stage pumps. A reason for the good performance of a single stage against high backing pressures is suggested.